THURSDAY, MAY 20, 1915.

SCIENCE AND THE STATE.

IN the *Chemical News* of April 30 there is a very moderate article emphasising what has been frequently preached in vain: the necessity of a close connection between the public Services and men of science. It is argued that the present is a special opportunity of again advocating the necessity of intimate co-ordination of effort; the societies have ever been willing to render gratuitous service; the Royal Society, for example, has for long put at the disposal of the Government the knowledge and advice of experts in all branches of science. The writer of the article, however, directs attention to the comparative scarcity of young men trained in research, and points out that it is by no means easy for a young graduate to obtain employment otherwise than by teaching. To rectify this state of affairs, he suggests the foundation of research institutes, where such young men could find employment (remunerative, it is to be presumed). These institutes should, it is remarked, be directed by men of eminence in their own branches, free from the irksome duty of teaching. The writer of the article further points out that while the average quality of German research is not high, still its quantity is great; and that British inventiveness is relatively higher. It is questionable whether his statement holds that the result of the German methods of scientific education has been the production of men of resource, men who are able to act promptly and on their own initiative in emergency; this power he believes that we British lack in the present crisis. I do not agree; it is not that power in which we are deficient, but the faculty of organisation, where each man is willing to do only the share which is allotted to him. That is the essential characteristic of the German; he lacks originality, but is content to form a cog in a system of wheels directed from above. Nor are the brains of this human machine original; they have learned how to appropriate and render commercial the ideas of inventors, chiefly those of the non-Germanic nations.

The deputations to Mr. Runciman and Mr. Pease of members of the Royal and the Chemical Societies, and of the Societies of Chemical Industry and Analysts, reported on in NATURE of May 13 (p. 295), urged the appointment of a Standing Committee, serving the purpose of an intelligence department, and also helping the large and growing chemical industries of the country in the same way that the Commercial Intelligence Department serves merchants and traders. It was pointed out that the expansion of the chemical industries of the country requires co-operation between science and manufacturers, and that an increase in the number of research workers is desirable. The speakers also insisted on the need of a more intelligent appreciation of the significance of original scientific work by the Government. To these remarks Mr. Runciman and Mr. Pease made sympathetic replies.

On the evening of the same day on which the report appeared in NATURE, Mr. Pease announced in the House the intention of the Government to create an Advisory Council on Industrial Research—a committee of experts who would be able to consult with other expert committees working in different directions, and associated with leaders of industry. "He was now considering names."

Now, we do not doubt the good will of the members of the Cabinet, but we distrust their judgment in this matter. The handling of the dye scheme was, to say the least of it, very unfortunate. There are two German works, one the Mersey works, a branch of the "Badische," and one at Ellesmere Port, a branch of the German works at Höchst, which might have been associated forcibly with this combine with advantage to the country; moreover, the total lack of chemical talent on the directorate does not argue for its success, as the public has testified by failing to subscribe the issue. The two "eminent chemists" who advised the Government on the dye scheme doubtless do not thank the member of the Cabinet for their unsought publicity. These and other similar instances lead us to mistrust the judgment of Mr. Pease and his colleagues on questions involving science.

There is certainly room for a chemical council, and I had already prepared a draft scheme about two months ago, which has been submitted to, and has had the general approval of, several of our leading industrial chemists. Perhaps it might help were an outline of the scheme to be given here. It is headed "A Draft Scheme of a Chemical Council of State." The clauses are as follow:—

1. The dependence of the welfare of a country on its chemists is obvious. Chemistry lies at the basis of practically all manufactures. Continental nations and the United States have long acknowledged this.

2. Great Britain is behind no nation in the eminence of its chemists. But inducements are lacking to persuade young men to accept minor

positions. Chemical research, as indeed all research, is of two kinds; capital discoveries are made by some, and in this Great Britain probably leads. But the patient development of known ground requires men of a different calibre—men of more ordinary attainments; such men are lacking in numbers in Great Britain.

3. Men of the first rank exist both in the universities and in industry. It is of these that the Chemical Council should consist. About twenty men of this class could easily be named, of the highest reputation and of great experience. Among them every one of the numerous branches of chemistry could be covered; one or more of them would be competent to give expert opinion on every subject which falls within the purview of chemistry.

4. The manufacturing chemists in Great Britain are, generally speaking, not combined. It is true that the alkali-makers work on a mutual understanding; so do the ironmasters. But chemical products are so varied that it may be truly said that industrial chemists work in isolation from each other. It is also generally true that there is little contact between industrial and scientific chemistry. The teachers and students in universities and colleges know little of what passes in the world of manufacture, nor do industrial chemists, as a rule, consult the heads of scientific laboratories. This, again, does not obtain abroad.

5. A Chemical Council for the United Kingdom or for the Empire should comprise both classes of men: scientific investigators and those who apply scientific discoveries to industry. It should contain about twenty-four members, of whom one-third should be technical chemists, one-third scientific investigators, and one-third analytical and consulting chemists.

6. Its duties should be:—

(*a*) To ascertain from every chemical factory in the kingdom (1) the nature of its raw material; (2) the nature and amount of its finished products; (3) the nature of its by-products and what becomes of them. Also to learn by inquiry of the purchasers and users of chemical products—(1) what articles they obtain from home manufacturers; (2) what articles they purchase from abroad; and (3) the causes which induce them to encourage foreign rather than home industries.

(*b*) To establish connection with the chemical laboratories of universities and colleges, and to bring chemical researchers into contact with manufacturers, so that the latter should indicate to the former what problems await solution; and the former should keep the latter posted in any discoveries which appear to promise to be of technical value.

(*c*) To advise the Government on questions involving a skilled knowledge of chemistry and its applications.

7. It would not be desirable to enlist the services of the members of such a committee free of remuneration; a small annual retainer would, however, be sufficient to create a feeling of responsibility. It would, of course, be necessary for the Council to employ agents, who must also be skilled chemists, to carry out such work as visiting factories and interviewing the heads of departments both of factories and colleges; also some clerks and typewriters would be essential.

8. It would make for efficiency if a certain proportion of the members of such a committee were to offer themselves for retirement annually, as do the directors of a company. It would be open to the remaining members to recommend their continuance in office or their replacement by fresh blood. If the Council consisted of twenty-four, eight members might retire each year, with the possibility of re-election.

9. This Council would resemble to some extent a Royal Commission, but it should be appointed for a term of years, say ten, with the possibility of continuance as a permanent body should its work be successful. It must be remembered that the progress of science and its applications has no end.

10. The Committee should report once a year at least, or even at shorter intervals, to the Crown. It would appear advisable not to attach it to any Government department, but to associate it with the Board of Trade, the Board of Agriculture and Fisheries, the Local Government Board, the Board of Education, and also with the Government laboratories.

11. As it is clearly of advantage that such a committee should be non-political, it would be well if it were appointed by and were directly responsible to the Crown.

To whom is the nomination of the first members of such a committee to be entrusted? For on that will depend its success or its failure. I suggest that the President of the Royal Society, himself a most distinguished chemist, should be asked to nominate from the Fellows four persons, two scientific chemists and two technical chemists; and that they, under his chairmanship, should select the names of twenty other persons, themselves constituting four members of the Council. It is unlikely that Sir William Crookes could be prevailed

on to add to his numerous onerous duties by himself serving on the Council; but he would probably consent to act as chairman of the electoral committee.

It is earnestly to be hoped that members of the Government will agree to adopt some such scheme. To embark without expert—real expert—advice on nominating the members of such a Council would be to expose it to risks equal to that attending the dye scheme, and would make it impossible to achieve the objects which they appear to have at heart. Let us hope that they will, in this case at least, trust the expert.

Lastly, it is earnestly to be hoped that Mr. Pease's good intentions will not take the form of the institution of a number of Government scholarships. It is grossly unfair to induce young men by scholarships to embark on a career which has little if no outlook; and that has hitherto largely been the case. The status of chemists in Government employment, for example, is not such as to induce any young man who can choose any other profession to devote himself to the career of an official chemist. Compared with other civil servants, he is underpaid and overworked. And although certain manufacturers, to their credit, maintain excellent laboratories, in which a young man has scope to show his ability and may meet with a suitable reward, yet these are the exception. It is to increasing their number and organising their resources that the efforts of the Chemical Council should be devoted.

The suggestion of the foundation of chemical institutes will not meet the case. Those at Dahlem, near Berlin, I am informed at first hand, are not appreciated by the young chemists who work in them; they do not lead to permanent positions. The same cause has resulted in the comparative failure of our Davy-Faraday Institution; and it would be futile to embark on an ambitious scheme for training research chemists without first making sure of their having a reasonable chance of earning a living when they leave.

WILLIAM RAMSAY.

A GREAT PLANT COLLECTOR.

Journal kept by David Douglas during his Travels in North America, 1823–1827. Pp. 364. (London: W. Wesley and Son, 1914.) Price 21*s*. net.

DAVID DOUGLAS, whose journals after lying neglected for nearly ninety years have recently been printed and published by the Royal Horticultural Society, was born near Scone, in Perthshire, in the year 1798. He was apprenticed as a gardener in the Earl of Mansfield's gardens at Scone. When he was about twenty years of age he went to the botanic garden at Glasgow, where at that time the elder Hooker held the position of professor of botany. He became Hooker's assistant and companion during his famous botanical tours in the western Highlands, and showed such a love and enthusiasm for plants that when the Royal Horticultural Society, in quest of a suitable man for a botanical expedition to North America, applied to Hooker, the latter at once recommended Douglas. Douglas accordingly visited the eastern United States and Canada in 1823. His journal describing this trip has but a mild interest, much of the ground he traversed having been already well trodden. He fulfilled his task, however, so much to the satisfaction of the Royal Horticultural Society that, in 1824, he was again dispatched to North America, this time to the western side. By reason of the number of plants he discovered and introduced this journey proved an epoch-making one, both in botany and horticulture. Douglas left Gravesend in July, 1824, and, going by way of the Straits of Magellan, reached the mouth of the Columbia River the following April. After two years' work in Oregon and California he returned by the overland route to York Factory, south of Hudson's Bay, and reached England in October, 1827. He made a second journey to the same regions in 1829, but of this the present volume gives no account.

Douglas stands undoubtedly in the very first rank of plant collectors, having as his compeers such men only as Masson, Allan Cunningham, William Lobb, Robert Fortune, and Wilson. The journals show that he possessed to a high degree those peculiar and diverse qualities that go to make a first-class plant collector—physical courage and endurance, contempt of hardships, a love and knowledge of botany, together with a certain business aptitude and adaptability to new surroundings. He enjoyed the advantage of a practically virgin field for his labours, for scarcely any botanical exploration had been done in this region since Vancouver's voyage of survey some thirty years before, when Archibald Menzies—Vancouver's surgeon and botanist—had made a few excursions near the coast. And not only was his field a virgin one; it comprised the finest sylva of temperate regions, one might even say, of the entire world.

These journals were written in simple style, often apparently after the day's journey was done, with no attempt at literary embellishment and agreeably free from any bombast or undue self-

consciousness, such as has been too often characteristic of self-educated men of Douglas's class. It is not often even that Douglas indulges in a reflection on the marvels of nature, new and wonderful as they must have appeared to him. Much of what he records is little more than what has happened on previous days, and is going to happen on succeeding ones. Yet in spite of a certain monotony, the narrative possesses that charm and interest which mark even the plainest story of the pioneer. Douglas was apparently but seldom in danger from Indians or animals, although, with regard to the former, the situation became strained on more than one occasion. Grizzly bears, too, provide an occasional excitement, and we have a glimpse (p. 217) of one of Douglas's companions hurriedly climbing an oak, with the claws of an angry grizzly so close behind that his coat and trousers were torn to tatters. But, on the whole, it was storm and rain, cold, swollen rivers, excessive fatigue, and an insecure food supply that made up the chief hardships of his wanderings. The botanical interest of his writings is not so great as it would have been had the plants he met with and enumerates been identified. There is not so much to interest one in a paragraph like "(467) *Poa* sp.; annual; small, creeping; on the sandy banks of rivers, plentiful," as there would be if we knew the particular grass to which he was referring.

One of the most interesting items in the narrative is the collector's quest for a pine of extraordinary dimensions of which from time to time he heard accounts. His final success in exciting circumstances is recorded on page 230:—

"About an hour's walk from my camp I was met by an Indian, who on discovering me strung his bow . . . and stood ready on the defence. As I was convinced this was prompted by fear, I laid my gun at my feet and waved my hand for him to come to me, which he did with great caution. With my pencil I made a rough sketch of the cone and pine I wanted and showed him it, when he instantly pointed to the hills about fifteen or twenty miles to the south. As I wanted to go in that direction he, seemingly with much good will, went with me. At midday I reached my long-wished pine, and lost no time in examining and endeavouring to collect specimens and seeds. Lest I should never see my friends to tell them verbally of this most beautiful and immense tree, I now state the dimensions of the largest one I could find blown down by the wind: Three feet from the ground, 57 feet 9 inches in circumference; 134 feet from the ground, 17 feet 5 inches; length, 215 feet."

The editor gives no indication of what this tree proved to be, but from the description we have no doubt that Douglas here describes the first discovery of that most wonderful of pines, *Pinus Lambertiana*. He was not permitted to get away from the spot unmolested, for in bringing down the cones with shots from his gun the reports brought some armed and painted Indians on the scene, and it was only after some hazardous moments and a combination of palaver and display of pugnacity that Douglas escaped with but three cones and a few twigs.

Where a plant is mentioned by Douglas under a name which is not now accepted, the editor has given its modern equivalent in a footnote. This, of course, is helpful in many instances, but where the collector was palpably in error the fact might have been pointed out. Douglas was in a new country, but he often erroneously assumed that a plant he found on the western side of America was identical with one he already knew on the eastern. A novice is thereby led to believe that *Abies balsamea, Pinus Strobus, Tsuga canadensis, Amelanchier canadensis, Picea rubra,* and several more eastern trees are to be found in Oregon or California.

We are given a portrait of Douglas (showing a mild but Napoleonic cast of countenance), but in reading the book one feels very much the need of a chart giving an indication of his itinerary. Some of his place names are not discoverable in the atlas. Considering the book is published at the not ungenerous price of one guinea net, we think this addition might reasonably have been made. In a series of appendices are given a brief memoir of Douglas, an account of some ascents of the mountains in the Sandwich Islands, a list of the plants he introduced, and an account of his early and tragic death at the age of thirty-six in the Sandwich Islands, where he fell into one of the pit-traps made to catch wild cattle, in which an infuriated animal was already entrapped.

APPLIED CATALYSIS.

The Hydrogenation of Oils, Catalyzers, and Catalysis, and the Generation of Hydrogen. By C. Ellis. Pp. x+340. (London: Constable and Co., Ltd., 1914.) Price 16*s.* net.

THE catalytic reduction of unsaturated carbon compounds by the direct action of hydrogen in the presence of a finely divided metal may be said to have been discovered by v. Wilde in 1874, when he succeeded in transforming ethylene into ethane by passing the unsaturated hydrocarbon mixed with hydrogen over platinum-black. Although this reaction was found to be of considerable service in synthetic chemistry, it remained without special significance until Sabatier

and Senderens started their epoch-making researches in 1897. These chemists found that finely divided metals other than platinum, namely, iron, cobalt, copper, and especially nickel, could be used with marked success as catalysts in reactions of this type, and the catalogue of Poulenc Frères, of Paris, bears witness to the practical success which has attended their work.

It is stated that the nickel most suitable for the purpose is obtained by reducing the oxide by hydrogen at a temperature of between 270° and 300°, but no one who has worked on this subject can have failed to experience the extraordinary differences in the activity of the metal produced under various experimental conditions, and it is therefore not surprising that no great technical use has been found for the process until within comparatively recent years.

The fact that the liquid or unsaturated fats of the olein type are unsuited for the purposes of soap-making, as well as for the production of edible fats, has caused numerous experiments to be made with the object of converting these substances, either wholly or partially, into the saturated or hard fats of the stearin series. As early as 1875 Goldschmidt showed that oleic acid could be reduced to stearic acid by phosphorus and hydriodic acid at a high temperature, and, indeed, this process, or a modification of it, was applied on the industrial scale at about this time, but the method was not successful, and it was not until W. Normann, in 1903, took out a patent for a "process for converting unsaturated fatty acids or their glycerides into saturated compounds" that the Sabatier and Senderens' method was applied to the saturation of unsaturated fats and the tremendous possibilities of the process from an industrial point of view became evident.

The patent of Normann was obviously bad, and it was rendered invalid in 1913, as the result of an action between Joseph Crosfield and Sons, Ltd., and Techno-chemical Laboratories, Ltd.

In the book under review, the first two chapters are devoted to a description of all the various processes which have been used for the purpose of effecting hydrogenation, and it is in this portion that the author seems to have erred on the side of over-elaboration. The point had evidently occurred to him, because, in his introduction he states that "The observations and opinions of many minds have been brought together. Some of these views obviously are sound, others are open to grave doubt, and still others are of a contradictory or polemical nature. Whether or not in the treatment of this material to carry through a vein of critical comment was a problem which confronted the author." That he decided not to introduce this vein of criticism and to give the value of his experience in discriminating between the various processes is, we think, a matter which will be regretted by the average reader. As it is, one almost feels inclined to say that some of the methods described could scarcely have been expected to yield satisfactory results even by their discoverers, and the reader who is not an expert will arrive at the conclusion that there are some fifty different ways by which hydrogenation may be accomplished, and that all of them are of equal importance. To the expert, however, who is able to sift grain from chaff, this section will be of the greatest service.

The same criticism applies to the next section of the book, which deals with the various kinds of catalysers which have been used. This section occupies two chapters, and is succeeded by an admirable account of nickel carbonyl, followed, in chapter vi., by an interesting account of the work of Paal and others on the use of the rare metals in the colloidal state as catalysts. Chapter viii. deals with the analytical constants of hydrogenated oils, and the two succeeding chapters contain a description of the methods by which these oils may be converted either into edible fats or into soap. The last nine chapters of the book, some hundred pages in all, deal with the various methods which have been devised for the preparation of hydrogen. This section is treated in a most exhaustive manner, and the influence of impurities in the hydrogen, acting either as poisons to the catalysts or as substances injurious to the oils, are discussed. The book ends with an appendix containing an account of the recent litigation over the Normann patent.

This excellent treatise is well illustrated by some 145 photographs and drawings both of scientific apparatus and of plant. The admirable manner in which the author has emphasised the scientific basis of the technical processes which he has described causes it to be a noteworthy addition to our literature on specialised organic chemistry. J. F. T.

A TEXT-BOOK OF EFFICIENCY.

Fundamental Sources of Efficiency. By Dr. F. Durell. Pp. 368. (Philadelphia and London: J. B. Lippincott Company, 1914.) Price 10*s.* 6*d.* net.

TO many it once came as a shock to hear that the great Mach laid stress on the economy of thought in science. It seemed as though science were brought into too close analogy with much more mundane kinds of human activity. But in this book the study of almost every conceivable kind of activity, including scientific activity, is made from the abstract

point of view of efficiency. "An efficient process is one in which the available results exceed the expenditure" (p. 4); and the work is an attempt to analyse the various forms and sources of efficiency into a few elemental principles. "While the book has been cast in a form adapted to general reading, groups of exercises have been inserted which, it is hoped, will add to its value if it is used as a text-book in any institution where the principles of efficiency are taught."

Surely it is only in America that we could have a professor of efficiency. From the preface we also learn that, since the importance of investigating the elements which constitute fitness, that is, efficiency, becomes evident as soon as the principle of the survival of the fittest is recognised, the leading ideas of the book were suggested by the reading of Herbert Spencer. Many important details have been obtained from the publications of the Efficiency Society and the works of various modern writers.

The most primitive and, in a sense, fundamental source of efficiency is the act of re-use or repetition, and human progress in general is marked by an increasing amount and by higher forms of re-use (p. 31). A superior efficiency to more or less haphazard re-use is attained by the "unit and multiplier principle" treated in chapter iii.: "A *unit* is any entity used manifoldly in space or time or in any relation. The *multiplier* expresses the number of manifold uses made of a unit" (p. 50). This principle may be extended so as to form a still more general agent of efficiency, that of the "group," and this is dealt with in chapter iv. The group is so fundamental in its nature that the other primal sources of efficiency may be regarded as various methods of using the group. Groups may be used not only singly, but also in combination, with a corresponding increase of efficiency (chapter v.). It is often a source of efficiency to substitute for a given system of groups a series of groups or "orders" of the system (chapter vi.). The use of an object or objects external to a given domain as a means of obtaining results by forming new and large groups is the source investigated in chapter vii.

Chapter viii. deals with sources obtained by the perceptions of diversities and of uniformities. After a study (chapter ix.) of the aims and ends of efficiency processes, chapter x. contains a good treatment of symbolism as an agent of efficiency, and here pp. 174–175, 177, 185, 187 (*cf.* p. 359) seem especially noteworthy. The other chapters are on the principle of directive action, the study of speed and rhythmic methods as means to efficiency, the principle of "dialectic" or unexpected discovery, the study of limitations of processes, the removal of waste and error, and the combinations of efficients. Chapter xviii. deals with applications to psychology, education, sociology, business, art, ethics, and religion. Finally, there are appendices on "The Categories and a General Philosophy of Life" and a "Historical Survey."

The book is rather obscurely written, but contains very much valuable illustrative material.

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OUR BOOKSHELF.

Elementary Human Biology. By J. E. Peabody and Dr. A. E. Hunt. Pp. xii + 194. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1915.) Price 4*s*.

UNDER this somewhat curious title the two authors, American schoolmasters, have produced a manual which deals with elementary hygiene. It is evidently written for children, for the pronunciation and derivation of comparatively simple words, such as involuntary and ventilation, are given. It, however, manifests a curious lack of perspective, for while it contains simple exercises which teach young pupils the reasons for rules of health, such as cleaning the teeth, masticating the food, and washing the skin, it also deals with elaborate details for comparing bacteriologically with Petri dishes the air of a room after sweeping it with a broom, and after the use of a vacuum cleaner. One home exercise which with unconscious humour is marked optional consists in chewing popped corn and noting that it becomes sweet during the process. The conditions of American life are so often different from those in this country, for instance, in the matters of heating and ventilating houses, that we doubt whether the present book will profitably replace the many excellent text-books on hygiene we already possess here; the same may be said in relation to subjects such as profitable housekeeping and cooking. Even if the English child or his parent overcomes the difficulty of converting dollars into shillings, we doubt whether they will be much enlightened by such words as skillet, round steak, and string beans.

A few of the many errors noted are: that milk-sugar is changed into grape-sugar by heating it with Fehling's solution; that the saliva forms dextrose from starch; that nerve impulses travel 100 ft. per second; that Nissl granules in nerve cells appear as a result of fatigue; that the epiglottis closes as a lid on the larynx during swallowing; that peptone is the end-product in digestive proteolysis; that Sylvester's method for artificial respiration is the best. Children, it is true, require teaching to be simple, but they deserve that it should be accurate. W. D. H.

Inorganic Plant Poisons and Stimulants. By Dr. W. E. Brenchley. Pp. ix + 110. (Cambridge: At the University Press, 1914.) Price 5*s*. net.

MISS BRENCHLEY has set herself a difficult task in attempting to deal with problems such as are indicated in the somewhat ambitious title of her

book, and we confess to a feeling akin to disappointment after a perusal of the volume. The work is good as far as it goes, but the treatment is less suggestive, and the grip less firm than we had been led to anticipate.

The effects of the salts of five elements, viz., copper, zinc, arsenic, boron, and manganese upon plant growth have been studied, and the surprisingly deleterious results which follow on the addition of minute traces of some of them to plants grown as water cultures are described, and are also illustrated by excellent photographs. The conclusion is reached that no stimulation of growth follows the addition of even the smallest amounts of salts of copper, zinc, or arsenic, whilst some improvement does occur when salts of boron or manganese are employed. This is of interest when the somewhat widespread notion of the beneficial action of traces of copper salts, in some instances, at any rate, is recalled. Naturally, however, one must accept with caution conclusions based on the results of water-culture experiments in any endeavour to extend them to plants growing under ordinary soil conditions. This is the more necessary when one reflects how differently plants may behave in pot culture and in the field, and that even in the field itself it is not possible always to predict results at all accurately when the soil, aspect, drainage, and other factors as well are all subject to variation. We need a far more intimate knowledge of the physical conditions, as well as of the chemical processes that are in part, and often largely, governed by those conditions in the soil, before we shall be in a position even to formulate these fundamental questions, a satisfactory answer to which must form the basis on which our real knowledge of the plant, in this connection, will have to be built up. Miss Brenchley is fully aware of the difficulties which surround the whole subject, and her summing up of the whole position is admirable in its caution.

Index to Periodicals. Compiled by various authorities and arranged by A. C. Piper. Vol. i., April—September, 1914. Pp. xxxii + 192. (London: Stanley Paul and Co., for *The Librarian and Book World.*) Price 21s. net.

THE general editor of this classified and annotated index to the original articles contained in some of the principal weekly, monthly, and quarterly periodicals, Mr. A. J. Philip, rather disarms criticism by recounting in the preface the difficulties due to the war under which the index has been prepared. The idea of such an index of the important signed articles in periodical literature was excellent, and had it been possible to carry it out with some completeness, the result would have been widely welcomed.

It is difficult to understand on what plan the 109 periodicals indexed have been chosen. The preface says that foreign periodicals have been omitted, yet the names of a few appear in the list of those indexed. The *Journals* of the Royal Anthropological Institute, the Royal Microscopical Society, the Royal Sanitary Institute, and the Royal Statistical Society have been dealt with, but the publications of the Royal Society, the Royal Astronomical Society, the Royal Meteorological Society, the Chemical Society, the various engineering institutions, and scores of others of equal importance are ignored. Similarly in education, attention is confined apparently to the *Educational Times*, the *Journal of Education*, and the *Parents' Review*, while no mention is made of the *Preparatory Schools Review*, the *School World*, the *Schoolmaster*, and a host of others. The *Classical Review* is indexed, but the periodicals concerned with modern languages, English studies, nature study, and so on, seem to have been forgotten.

While appreciating the enterprising beginning which has been made, it may be hoped that in the next volume the compilers will cast their nets more widely, and so secure a more representative production.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The National Organisation of Scientific Effort.

FOR readers of NATURE one of the most striking features of the war is that the German Government should be approved and supported by its prominent men of science, in spite of the fact that it uses methods of warfare which we regard as being outside the pale of humanity and common civilisation. It seems inconceivable that anything like it should happen in this country. If the British military authorities had transgressed against the written and unwritten laws of humanity as Germany has done, we feel sure that our men of science would have found a voice in condemnation of the Government. In this country it is no unusual thing for men of science to find a voice in condemnation of the Government, both for what it does and for what it leaves undone. Such condemnation used, in fact, to be, in peace time, a staple article of scientific public-speaking, the like of which one did not find in Germany. One never heard there even in private conversation the kind of criticism of Government action or inaction which in this country is reiterated commonplace.

The difference in practice may be attributed to the fact that in Germany scientific effort is organised by Government, which stands to scientific work in the relation of creator, provider and guardian, on its own terms. In Germany, Government is the providence of science; and to rail against Government, even when its ways are dark and mysterious, is not to be thought of. The attitude of the man of science in Germany towards his Government recalls Cowper's hymn. Changing the grammatical gender to avoid irreverence:—

> Blind unbelief is sure to err
> And scan Its work in vain,
> It is Its own interpreter
> And It will make it plain.

We have nothing like it in this country, and this reflection prompts the question: What is the corresponding organisation in this country? For organisation there must be, whether it be simple or elaborate, effective or ineffective, intentional or haphazard.

Our organisation is, in fact, haphazard, a matter of history and tradition; and, on examination, it

will be found to be at least moderately efficient as regards persons, but woefully inadequate as regards subjects.

The difference is well pointed by an incident at a dinner in connection with a scientific meeting a few years ago. The speaking, after dinner, had become rather informal, and one of the foreign representatives urged the desirability of a professorship in, say, seismology—the particular subject is unimportant—and, in reply, the chairman said that he had recognised the need for a long time, and was uncertain whether the best way of approaching its satisfaction was to appeal directly to the universities, or to begin with the schools and so create a demand which the universities would find it to their interest to meet. The German representative on leaving the dining-room remarked: "But, of course, *your Government* must create a professorship." The only reply to that is that it is not our way.

Then what is our way? To what authority in this country does one appeal for the promotion of the study of any scientific subject which is felt to be in want of support?

There is the Royal Society, which is known to be a remarkably powerful body for discriminating between the merits of the scientific workers in this country. Some years ago one of its presidents devoted a series of presidential addresses to the claims of science in education; but to ask the Royal Society to put machinery in motion to supply the need for university professorships in certain subjects would be simply to court a rebuff, and for an obvious reason. It is understood that the Royal Society, though it is, for some purposes, a representative body, does not regard itself as the proper body to take the initiative in approaching the Government for the support of a new scientific project. The proper course is supposed to be for those who are interested in the project to approach the Government themselves, and for the Government to refer the matter to the Royal Society as a kind of jury. By that mode of procedure the promoters, without the official support of the representatives of science, have first to convince the Government that their project comes within its province, a task that in itself is enough to damp the ardour of many enthusiasts.

If the Royal Society is shy of approaching the Government, it would be still more shy of approaching directly an academic corporate body. That is not to be thought of. Besides, it is itself academic enough to know the answer without going through the formality of making the inquiry.

Nor is it likely that an avenue to the purse of the private benefactor could be found through the corporate action of the Royal Society, although without such action any appeal is prejudiced from the start. It can scarcely be doubted that if the Royal Society would from time to time set out the gaps in the professorial ranks of the universities on account of subjects of deep human and scientific interest which have no exponents in the academic life of this country (and so, by conscious or unconscious imitation, of the British Empire), the appeal would carry conviction to some of those who are willing to consider a worthy outlet for part of their wealth. The contention that the British Empire is not rich, or at least not rich enough to staff its universities properly, will not really bear examination; and yet the very dignity of the Royal Society seems too great for it to undertake the duty of appealing for funds for separate subjects that need support.

So we are back again at the usual refuge for science in distress: the Government. The front door is closed, as we have seen, but we can try the back.

Let us concentrate our attention on the "research" aspect of the question and appeal for support to the "Government grant for scientific research" which is administered with a free hand by a committee appointed by the Royal Society. It is common knowledge that the committee acts ostensibly on the principle that for research in this country all that the Government needs to provide is a number of small doles to enthusiastic workers who find themselves deficient in apparatus and materials. The sums necessary for the maintenance and remuneration of these workers have to be provided by other means—into which the Government Grant Committee is careful not to inquire.

But with the neglected subjects to which we have been referring, research has to be initiated and workers found and paid: the Government Grant Committee draws the line there. It is a very unfortunate conclusion, because any appeal to Government for research from anybody but the Royal Society can be, and indeed is, rightly estopped by a reference to the provision which already exists for scientific research, and which is not officially known to be inadequate.

Here again the Royal Society shows itself admirably efficient in discriminating between the merits of the persons who apply for the doles, but it has practically nothing to say to the appeal for subjects left entirely in the cold.

Is it unjust to sum up the situation with regard to the subject-aspect of our national organisation of scientific effort by saying that it is in this unfortunate position: that on the one hand nothing can be done without the Royal Society, and on the other hand, with all respect and admiration, nothing can be done through the Royal Society?

Yet things are done from time to time; ways out of the dilemma have been found; our existing organisation must have other aspects. Parenthetically it is a matter for wonder how the subject of mineralogy came by the provision which it now enjoys at the older universities. One has the feeling that if it had not been endowed long ago it would never be endowed now. It seems even further from the important consideration of the "main chance" which appeals to the universities than some other subjects which have still no academic status.

Looking back at the history of the other subjects which may be included in the title of out-of-door physics, we find that the British Association for the Advancement of Science stands out as the specialised organ of our national organisation for giving things a start. One knows the mode of procedure quite well. Certain prominent men of science (who when they are back in London will be the Royal Society) meet in some provincial town, discuss the matter, appoint a committee, and make a grant out of the members' pounds for out-of-pocket expenses. The subject prospers by the unpaid work of some indefatigable member of the committee; after some years an appeal is made to Government. The British Association conducts the appeal, which is thereby guaranteed respectful consideration; and its reception by the Royal Society jury is also guaranteed by the *personnel* of the committee; there is no element of danger in the reference, and so the plan is brought to some sort of fruition.

To the operation of the British Association can be traced the origin of what provision there is (outside the Royal Observatories, the Hydrographic Department of the Navy, and one division of the Meteorological Office) for meteorology, terrestrial magnetism, solar physics, seismology and the so-called "Standardisation" of instruments, now represented by the National Physical Laboratory. For each of these one

or more committees of the British Association could be named, one of which dates as far back as 1842, early days even for the British Association. There are, no doubt, many other enterprises in other branches of science which have a similar history.

So the organisation of scientific effort on our side which corresponds with the Government organisation of Germany may be expressed by this precept for anyone who has a project for scientific work: "You first attend a meeting of the British Association and get a strong committee appointed; then you work for a number of years without pay, but with a mind conscious that you will thereby acquire merit with the Royal Society, the great discriminator; then if you have not money enough to pay for apparatus you can appeal to the Government Grant Committee with an assured prospect of success; then when you find it necessary for somebody to be paid, you can move the Council of the British Association to approach the Government for the money. The Government will then take the opinion of the Royal Society, and that will be quite all right, because your own committee will be in force there; and then, if you are moderately fortunate, Government will give you half of what you ask as a 'grant in aid,' and for the rest you must look out for yourself."

We are therefore by no means devoid of organisation; what we have is almost venerably historic and very elaborate; but it is long and tortuous and sadly inefficient for the following obvious reasons:—

First, that in spite of our pride in private effort, and our prejudice in its favour as being vastly superior to anything that Government can do, our process leads ultimately to Government and nowhere else. It gives no footing in the universities or in any other body, corporate or incorporate, whose members control the temporary destinies of the British Association. Of course, at the end of the chapter the Government could approach the universities, but with the present relations between Government and the universities this is a perilous thing for a Government to do. It was done in one instance lately; and there is "a smile on the face of the tiger."

Secondly, it leads to accepting Government money in the form of what is called a "grant in aid," which means public money with public responsibility, but no official prestige and no official purpose. The grant is made as a concession to somebody's enthusiasm; the responsibility for success rests with the unfortunate enthusiast, and the limitation of ways and means rests with somebody else. One of the common forms of our scientific attitude is that Government support chills and discourages private effort. The scientific societies are fond of adopting it because it leaves them in a sort of control of things; and, of course, Government "as at present advised" is not likely to demur. But what attracts and stimulates private effort is really efficiency, whether public or private; it is frequently the case that support by Government lacks that stimulating quality simply because it represents not a purpose, but a concession. The situation recalls a remark once heard at a college dinner-table, when a country clergyman thus expressed himself concerning the Nonconformist discontent about education: "I cannot see what these dissenters have to complain of; we *tolerate* them." So with our national organisation of scientific effort: it ends in toleration by the Government, and the "establishment" looks on with a sort of bewildered wonder at our insatiable discontent.

Among the changes which will follow the war, whatever the issue may be, the reorganisation of scientific effort must find a place. All the after-dinner speeches about the parsimony of the Treasury, and all the complaints in *Science Progress* and at the meetings of the British Science Guild, punctuated by what has been brought to light since the war began, mean at least that.

We may learn from our enemies and let the Government take over the control of our scientific effort, or, appalled by the result in the case of Germany, and sharing the feeling of Prof. Brants and the Dutch for whom he speaks in the March number of the *Nineteenth Century and After*, we may have the courage to be ourselves and manage things in our own way. The future will show; only we must have a way which is recognisable and recognised. Behind the Government, whether in association with a special Minister or not, there must be a powerful advisory committee with facilities for initiation as well as discrimination, a sort of Privy Council for Science with public responsibilities, to whom the public as well as the Government can appeal.

Before that can be established the Royal Society must settle what its function is to be. At present it claims to discriminate in its corporate capacity, and leaves to its individual members the duties of initiation. The British Science Guild has sought to remedy this state of affairs, and is prepared to take the initiative in an organised way. But it is evident that, if the Royal Society is to exercise the power of discrimination, the two bodies must be in reality the same persons, as in the case of the initiative of the British Association, or the scientific body-politic will be divided against itself; therefore the first question to be settled is whether the Royal Society's claim to the power of discrimination is to be confirmed and supplemented by the faculty of initiative, or whether both faculties are to be vested in a recognised and responsible body of Government advisers.

The Royal Society is by no means an ideal institution for the purpose, and it was not created for such work; its full body of four hundred and fifty members is too numerous to carry the responsibility, and its Council of twenty-one too small, too much selected for the purpose of personal discrimination, too transitory, too full of work of other kinds, too much unpaid, and not sufficiently representative of the subjects with which a national organisation must deal in the long run because they are not adequately represented at the universities.

The point is obviously a difficulty; but in the long last it can only be settled in one way, and the sooner the Royal Society takes the field with a proposal for an initiating and discriminating advisory body other than its own Council the sooner will it be possible to take a definite step in the direction of the national organisation of scientific effort. F.R.S.

Osmotics.

IN connection with the recent discussion, at the Faraday Society, on osmotic and vapour pressures, it seems worth while to state that a long and laborious series of vapour pressure measurements which Mr. Hartley and I have undertaken is nearly completed, and I hope will be published shortly.

The results so far go to show that by taking $RT = 22{\cdot}3909$ (in litres and atmospheres, and with $O = 16$), which is the value for nitrogen and close to that derived from water vapour at 30° C., a very good agreement is obtained between the direct and indirect values of the osmotic pressure of cane-sugar at 0° C., and incidentally of calcium ferrocyanide.

I also take the opportunity of mentioning that if p be the osmotic pressure, V and v the volume of solution and volume of water containing one gram-mole-

cule of cane-sugar, respectively—both being measured when compressed to the osmotic pressure—then $p(v-bv/V)=RT$ is found to give a fair fit to the results both at 0° C. and at 30° C.

A closer approximation is obtained with

$$(p-a/v^2)(v-v/Vb)=RT,$$

in which case the same constants give the values of p for both 0° C. and 30° C.

I also find that a somewhat less good fit is obtained from $(p+a/v^2)(v-vb/V)=RT$; this last equation, however, has the advantage that it gives a value of V when $dp/dV=0$, which, assuming that this point is the limit of supersaturation, we know is about right; that is, V is greater than the molecular volume of cane-sugar in the solution, and less than its value in a saturated solution, *i.e.*, a solution containing about 960 grams per litre at 30° C.

I would reserve the discussion of the meaning of these equations and others, which I have also obtained, until our final results are published.

BERKELEY.

Foxcombe, near Oxford, May 15.

A Bibliography of Fishes.

THE time is ripe—and has, indeed, long been ripe—for the publication of a carefully prepared bibliography of fishes, to cover the entire range of the subject: fishes fossil as well as living, and fishes from many points of view, such as anatomy, physiology, embryology, pathology, parasitology, distribution, taxonomy, everything, in short, excepting matters which deal with clerical details of the fisheries. Such a compilation, it is clear, means much for this branch of zoology, for the literature of the fishes is vast, widely scattered, and ill-digested. In fact, I believe that there is scarcely an investigator to-day who has not been obliged, needlessly, to give weeks or months of his time to searching for references.

The importance of such a bibliography was brought home to me about 1890; at that time I began the work of collecting references to be used in my studies, and as years passed I was able to build up a card-catalogue giving author and subject, which proved indispensable. Later my catalogue became known to correspondents, who in turn found it of use in their studies; and they, for their part, were generous in contributing references, and thus added notably to its value. It next, through the kindness of the Smithsonian Institution, absorbed the bibliography which Prof. Goode undertook to publish, and which his death left unfinished. Thus the value of the work became greater year by year. About 1910 the American Museum of Natural History allowed me secretarial help in the direction of editing the catalogue for publication. And thereafter, for about a year and a half this secretarial work was carefully carried on under the supervision of my colleague, Dr. Louis Hussakof, and since 1914 by Dr. C. R. Eastman, of the American Museum.

The scope of the undertaking may be understood when one considers that nearly 50,000 references are brought together. These have been gathered from all sources, notably from all accessible bibliographies, serial publications, and book catalogues. Finally, the effort was made to complete the lists of titles by bibliographies secured in so far as possible from authors themselves. To this end circulars were sent out to several hundred writers on ichthyology, many of whom responded cordially.

There still remain, however, a number of individual writers who have not contributed the titles of their publications. I have, accordingly, been led to publish the present note in the hope that any who have not already sent to Dr. Eastman or myself their bibliographies, may be reminded that we are especially anxious to make the work as complete as possible. We urge that their lists be sent in without delay, for the work is undergoing its final revision, and the first volume is shortly to go to press. This is the "author's" volume, which will consist of about 1000 pages, and include under the names of writers a serial list of their publications. The second, or "subject" volume, will be a classified index of the titles in vol. i. Here one has access to special papers in the various branches; for example, in anatomy, distribution, embryology.

BASHFORD DEAN.

American Museum of Natural History, New York.

The Use of the Term "Pinacoid" in Crystallography.

CAN any of your readers help me as to the original definition of the familiar term "pinacoid"? I suspect that it was introduced by C. F. Naumann about 1830; it was derived from πίναξ, a slab, and appears from the first to have included two parallel planes. Naumann, for instance ("Anfangsgründe der Krystallographie," 1841, p. 126), uses "basal pinacoid" for the pair of planes parallel to the two lateral crystallographic axes. But he restricts the use of pinacoid to the three possible pairs in a crystal that cut only one of the three axes, and (p. 19) defines a pinacoid as including "two parallel planes which are parallel either with the base or one of the other co-ordinate planes."

In 1856 we find Tennant and Mitchell ("Mineralogy and Crystallography") using pinacoid for a single plane of any of these pairs, and this, which is clearly a mistake, has been followed by writers of very recent date. Story-Maskelyne ("Crystallography," 1895, p. 20) agrees with Naumann, calling the single plane a "pinacoid plane." This latter fact has not been observed by the authors of the Oxford Dictionary. P. Groth ("Physikalische Krystallographie") in 1876 and 1885 employed the term in Naumann's way; but in his third edition of 1895 he introduced the term "pedion" (p. 337) for any single plane, and defined a pinacoid (p. 340) as consisting of any two parallel planes.

This extension of the term pinacoid from Naumann's original usage has been adopted by Lewis, Liebisch, Miers, and Tutton in their authoritative works. The pinacoids parallel to the three co-ordinate planes are thus left without a distinctive title, and in my own small "Outlines of Mineralogy" (1913) I have styled them "principal pinacoids." If the history of the matter is as I have traced it, it would seem better if Groth had invented a new term, side by side with pedion, rather than, as was so often done by Rosenbusch in the nomenclature of rocks, employed a well-established term in a new signification.

GRENVILLE A. J. COLE.

Royal College of Science for Ireland,
Dublin, May 11.

A Mistaken Butterfly.

A FEW summers ago I noticed a fine cabbage butterfly executing a number of gyrations in front of a milliner's shop in New Bond Street, and making every effort to get through the plate-glass window. Immediately inside the window was a lady's hat (or bonnet, I am not sure of the distinction), ornamented by an enormous artificial scarlet poppy. It was quite clear that the object of the butterfly's attention was the poppy. Apparently he was guided by sight, and not by smell.

EDWARD A. MARTIN.

Grange Wood Museum, South Norwood, May 12.

ETHNOGRAPHIC STUDIES IN MELANESIA.[1]

THE two volumes of "The History of Melanesian Society," by Dr. Rivers, represent two methods of the study of mankind, the ethnographical and the ethnological. The first volume is devoted to an ethnographical study of a considerable portion of southern and central Melanesia and of various Polynesian islands; the account of Tikopia is of especial interest, as, although situated in Melanesia, it is inhabited by Polynesians, who have scarcely been affected by external influences. Most of the data were collected under the auspices of the Percy Sladen Trust. In the second volume the author breaks new ground in ethnology, as he synthesises and gives explanations of an even wider array of facts than those accumulated in the first volume.

Those who are acquainted with the previous writings of Dr. Rivers are well aware that, whether recording new facts or correcting and expanding information acquired by others, he has always paid great attention to method; indeed, he has perhaps done more than anyone else in this country to establish ethnology on scientific methods. It is interesting to note that until he began writing the theoretical discussion in the second volume, he was a firm adherent of the current English school, being almost exclusively interested in the evolution of belief, custom, and institution, and paying little attention to the complexity of the several cultures. He came to see, however, that Melanesian culture was more complex than had at first appeared, and that it was necessary to dissect out, so to speak, the associated elements in each of the component cultures.

Graebner was the first to study this problem systematically, but he approached it from the point of view of the museum curator without experience as a field ethnologist. Dr. Rivers states that the chief aim of his book "has been to show how social institutions and customs have arisen as the result of the interaction between peoples, the resulting compound resembling that produced by a chemical mixture in that it requires a process of analysis to discover its composition. To Graebner, on the other hand, the process of blending of cultures resembles rather a physical mixture in which the component elements exist side by side readily distinguishable from one another. . . . . He assumes that social institutions and religious practices can be carried about the world and transplanted into new homes as easily, and with as little modification, as weapons and implements. . . . Such an assumption is impossible to anyone who appreciates the far more vital and essential character of the less material elements of culture" (ii., p. 585).

By means of the genealogical method Dr. Rivers has discovered several remarkable forms of marriage in Melanesia, or has deduced forms which have existed previously. For example,

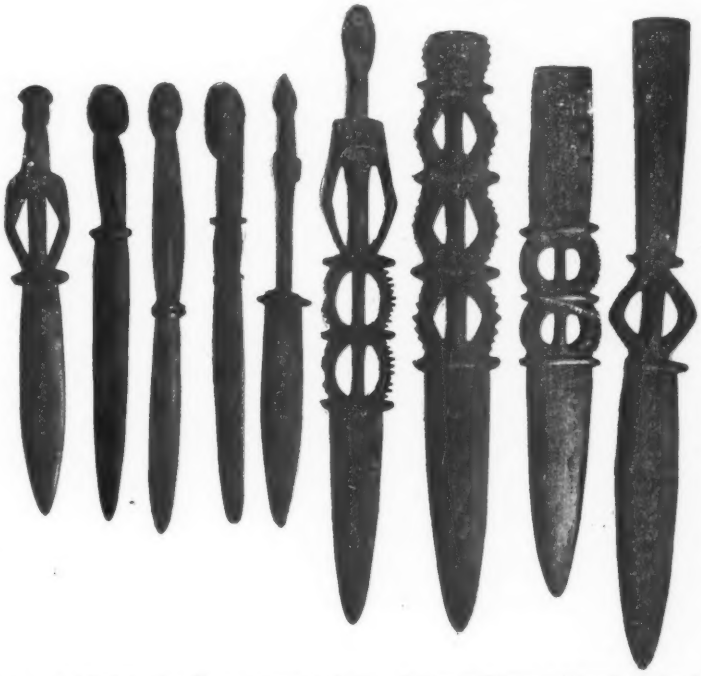

FIG. 1.—Pudding-knives from Ureparapara, Banks Islands. From "The History of Melanesian Society."

cross-cousin marriage (*i.e.*, between the children of a brother and those of his sister) occurs in widely separated parts of Melanesia, and wherever found is accompanied by features of the systems of relationship which are clearly the direct result of this form of marriage; these features are found in places where cross-cousin marriage does not now take place, but they must certainly be survivals of it. The same applies to marriage with the wife of the mother's brother. The extraordinary system of the island of Pentecost owes its special features to two anomalous forms of marriage which either still exist or have been practised on the island, viz., marriage with the wife of a mother's brother, and with the granddaughter of the brother. For the latter, there

[1] "Percy Sladen Trust Expedition to Melanesia. The History of Melanesian Society." By W. H. R. Rivers. Vol. i., pp. xii+400; Vol. ii., pp. 610. (Cambridge: At the University Press, 1914.) Price 36s. net two volumes.

is a clear tradition of its occurrence in the past, and it is said still to be practised. This form of marriage also takes place among the Dieri of Australia, who recognise that relatives belonging to generations twice removed from one another are naturally husband and wife (ii., p. 47). Dr. Rivers will be interested to learn that Sarat Chandra Roy, in his forthcoming book on the Oraons of Chota Nagpur, will produce evidence to show that there are "reasons for inferring the former existence amongst the Oraons (before clan exogamy was instituted) of a system of marriage or union between persons related to each other as grandparent (or grand-uncle or grand-aunt) and grandchild (or grand-nephew or grand-niece)." These archaic social institutions may be preserved in nomenclature like flies in amber. Dr. Rivers argues that the anomalous forms of marriage imply a dual organisation with matrilineal descent, and he is driven to assume a state of

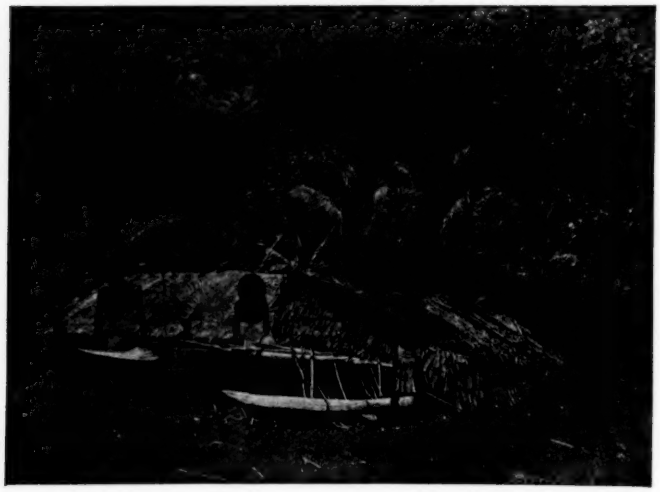

FIG. 2.—Canoe and canoe-shed, Tikopia. From "The History of Melanesian Society."

society in which the elders had acquired so predominant a position that they were able to monopolise all the young women. He also points out that, according to this view, cross-cousin marriage arose as a modification of the marriage with the wife of the mother's brother.

Dr. Rivers has made a special study of the secret societies of Melanesia, and he works out an elaborate argument to show that the secret ceremonial is derived from rites brought by an immigrant people, relatively few in number, who were solely of the male sex, or accompanied by very few women of their own race. By considering the distribution and the customs and objects associated with betel-chewing and kava-drinking, he shows that these comestibles mark two main migrations into Melanesia, which previously was inhabited by a people with a dual organisation. Various methods of the disposal of the dead indicate racial complexity, and a study of each mode combined with associated data leads to a finer analysis. His conclusions may be summarised as follows:—

The introduction of betel-chewing was relatively late and restricted and may have taken place from Indonesia after the invasion of the Hindus. With it were associated marriage with the wife of the father's brother, the special sanctity of the skull, and the plank-built canoe.

The effect of the kava-using peoples was more extensive in time and space; they had neither clan organisation nor exogamy, some preserved the body, and respect was paid to the head or skull. Contact with the earlier populations resulted in wife purchase and the development of secret societies. They introduced the cult of the dead and the institutions of taboo, totemism, and chieftainship, an outrigger canoe, money, the slit drum or gong, the conch trumpet, megalithic monuments, and the fowl, pig, and dog. There may have been two immigrations of peoples who made monuments of stone. (1) Those who erected the more dolmen-like structures, probably had aquatic totems, and interred their dead in the extended position; (2) and later, those whose stone structures tended to take the form of pyramids, who had bird totems, practised a cult of the sun, and cremated their dead.

These immigrants found a people divided into two exogamous groups, with matrilineal descent, and three special forms of marriage (with daughter's daughter, wife of mother's brother, and wife of father's father), they had rectilinear decorative designs, and employed the bullroarer. The dual organisation seems to have been formed by fusion rather than by fission, judging from the frequent survival of hostility between the two moieties, their mythology, character, and possibly even slight traces of differences in physique. Whatever the previous social condition of each moiety, a fusion of two races under certain conditions might produce matrilineal descent. The dual organisation would thus imply a dual origin, of which the immigrant people spoke an Austronesian language (as did the kava and betel peoples), interred their dead in a sitting position, feared the dead, believed in spirits, practised circumcision, introduced the bow and arrow, and an outrigger canoe. The Baining of New Britain may represent, though, of course, in a modified form, the aboriginal elements of the dual people; they are devoid of any fear of the dead, and their small stature suggests that the pre-dual people may have been pygmies.

Dr. Rivers has produced a work which will have far-reaching results, it being not merely a storehouse of facts, but a demonstration of

method, and conclusions are arrived at which will be sure to provoke discussion. Whatever may be the final results of such discussions, this book will probably take rank as a landmark in the study of ethnology. A. C. HADDON.

TYPHUS FEVER.

TYPHUS fever, which has just appeared in some of the prisoners' camps in Germany and is rife in Serbia, has been one of the great epidemic diseases of the world. Hirsch remarked:—"The history of typhus is written in those dark pages of the world's story which tell of the grievous visitations of mankind by war, famine, and misery of every kind."

The name is of no great antiquity, for it was applied to a malady or group of maladies first by Sauvages in 1759. Until then, from the time of Hippocrates downwards, it had been employed to designate a confused state of intellect, with a tendency to stupor. It was, in fact, not until 1850 that typhus fever was finally differentiated from typhoid or enteric fever by the researches of Jenner. One of the older synonyms for the disease was *jail fever*, and in the sixteenth century, at the first three of the famous "Black Assizes," judges, sheriffs, and jurymen were stricken with it as the result of infection from prisoners brought for trial. Another name formerly given to it is *Morbus castrensis* or "military fever," on account of the ravages occasioned by it among soldiers and camp followers from the time of the Thirty Years' War and the English Civil War down to the siege of Sebastopol. Owing to the character of the eruption, typhus fever has sometimes been termed "spotted fever" (to be distinguished from cerebro-spinal fever, also known as spotted fever), and the German name is *flecktyphus*, also *typhus exanthematicus*, to distinguish it from *typhus abdominalis*, typhoid or enteric fever. The French name is similarly *typhus exanthématique*. Brill's disease, met with in New York, and Tabadillo of Mexico, seem to be manifestations of it. Few countries have suffered more than Ireland, and the disease has lingered in the outer Hebrides, but of late years has been practically unknown in England, and is seen but rarely in Scotland.

The invasion of typhus is, in the majority of cases, like pneumonia, sudden and severe after an incubation period of about twelve days. On the fourth or fifth day the eruption appears, first measly in character, but appearing on the wrists, trunk, and thighs, and afterwards becoming hæmorrhagic. The patient then suffers from severe fever with its usual concomitants, passing into extreme prostration. The nervous system suffers severely, and there is great muscular restlessness and tremor, excitement and delirium. In favourable cases the attack ends comparatively suddenly about the fourteenth day.

There are, of course, considerable variations in the course of the disease in individual cases; it is always to be regarded as a serious affection, and the average death-rate for all ages under favourable conditions is 15–19 per cent.; no age is exempt. An attack of typhus affords marked protection, and second attacks are as rare as those of small-pox. No special treatment for it has yet been discovered.

The ætiology of the disease is still uncertain: no specific micro-organism has been discovered, but it is probably protozoan in nature.

Typhus is markedly infectious, and the infectivity is greater the larger the number of cases which are aggregated together. The mode of spread for a long time was uncertain, and until recently it was regarded as being conveyed by the emanations from the patient. A few years ago, in the epidemic which occurred in Aberdeen, Prof. Matthew Hay made the pregnant suggestion, on epidemiological grounds, that the disease might be conveyed by fleas. Further investigations have conclusively proved that it is conveyed by the body-louse, possibly by the head-louse also. This important fact explains how it is that typhus is so prone to appear in times of stress, war, and famine—when misery prevails and personal cleanliness is difficult or impossible to maintain.

Prevention of the spread of the disease largely resolves itself, therefore, into extermination of lice, and much attention is now being directed to the means which may attain this end. R. T. H.

AN ADVISORY COUNCIL ON INDUSTRIAL RESEARCH.

THE proposed formation of an Advisory Council concerned with industrial and scientific research was announced by Mr. J. A. Pease, President of the Board of Education, to the deputation of which we gave an account last week. The scheme was described by Mr. Pease in Committee of the House of Commons on May 13 in connection with the Education Estimates; and the debate which followed upon it was one of the most important from a scientific point of view that has been heard in the House for a long time.

The general question of the relation of science to the State, and the particular work which a suitably constituted Advisory Council could undertake, are dealt with elsewhere in this issue of NATURE by Sir William Ramsay. We need scarcely remind our readers that the need for increased provision for research in pure and applied science has been urged in these columns for many years by leaders in the scientific world concerned not only with the advancement of natural knowledge, but also with the promotion of national prosperity. For the past ten years the British Science Guild has been continuously endeavouring, with little encouragement, to secure public and official recognition of scientific research and organisation as essential factors of industrial progress. It has shown over and over again that whereas in Germany the State fosters all work and institutions engaged in scientific work and advanced technology, and in the United States

private benefactions increase the endowments for such purposes at the rate of about 5,000,000*l.* annually, in the United Kingdom neither the State nor the generosity of individuals makes provision for research on a scale at all comparable with what is done in the two countries which are our chief competitors in the industrial world.

The war has brought to the forefront the national necessities to which Sir Norman Lockyer directed attention in his presidential address to the British Association at Southport in 1903, and throughout its existence the British Science Guild has persistently endeavoured to stimulate action which would encourage the expansion, and promote the use, of the scientific forces of the Empire. At last both men of science and members of Parliament have awakened to a sense of the importance of these matters; and, as we reported last week, representatives of the Royal Society and the Chemical Society have urged upon the Government the need for intimate interest by the State in scientific research and its relation to manufactures. We congratulate these and other societies upon the support thus given to the efforts of the British Science Guild to organise scientific work in the interests of national welfare.

Political leaders have expressed, from time to time, their sympathetic interest in scientific investigation and their belief in its influence upon industrial development, but until now little attempt has been made to give practical value to their profession. The unanimity with which the scheme put forward by Mr. Pease was supported in the House of Commons shows that all parties are prepared to make adequate provision for scientific work and its organisation in the interests of industry when a definite policy is proposed. We reprint below, from the official report of the debate on May 13 (Parliamentary Debates, vol. lxxi., No. 52) the main parts of speeches referring to the Advisory Council.

MR. PEASE: The war has brought home to us and to our notice that we have been far too dependent for very many processes and many materials upon the foreigner, and we have realised that it is essential, if we are going to maintain our position in the world, to make better use of our scientifically trained workers, that we must increase the number of those workers, and that we must endeavour to secure that industry is closely associated with our scientific workers, and promote a proper system of encouragement of research workers, especially in our universities. The fault in the past, no doubt, has been partly due to the remissness on the part of the Government in failing to create careers for scientific men. It has also, I think, been due partly to the universities, who have not realised how important it is that pure science ought to be utilised with applied science and brought into close contact with manufacturing interests. I think it was also partly due to the fact that the manufacturers themselves under-valued the importance of science in connection with their particular industries. It was partly due, too, to the fact that the ratepayers have been too niggardly in making provision in connection with their technical institutions and colleges.

I ought, perhaps, to give a few illustrations to the House in order to show that by expenditure in the first instance of a comparatively small sum of money, which ought to develop into very substantial sums of money in the future, much can be done by research workers, and by properly scientifically trained individuals in regard to many of those processes for which hitherto we have been dependent upon other countries. We relied upon Germany for hard porcelain tubes used in pyrometers which are required for measuring high temperature. On a supply of these pyrometers depends the manufacture of needles required for the sewing of boots and providing the footgear of our troops. I am glad to say that, owing to the research work that has taken place recently, we are now able to produce as good porcelain as that previously produced for this purpose in Germany, and we are able, therefore, to produce the necessary needles for this purpose. It may astonish the House when I tell them that, whereas four firms in Germany employ 1000 chemists in connection with their dye works, in the whole of our industries there are only 1500 chemists employed. There are in Germany more than 3000 students, even at the present time, so far as I can learn, studying research work in connection with their university life, whilst in this country I do not think we have more than 350 students engaged in such research work. Let me give another illustration of the success which may be secured by research work. Our successes over our enemy in aviation are very largely due to the investigations made into automatic stability by a young man who went through an elementary school, fought his way up to the Imperial College, and went through a course at the National Physical Laboratory, and invented and introduced the B.E. biplane—at any rate, from his investigations the B.E. biplane was developed. We have hitherto done very little to encourage these brilliant young men taking up a scientific career.

The average salary given to a junior teacher of science is, I am told, only about 150*l.* a year. With a meagre salary of that kind it is not to be expected that individuals are going to endeavour to enter a career which is so badly rewarded. Let me give the Committee just one other illustration of what research may do. Lyddite was made at the commencement of the war out of phenol. The price went up at once from 6*d.* to 5*s.*, and owing to laboratory experiments conducted by Prof. Green at Leeds he was able to reduce the cost to 1*s.*, as lyddite can now be made from benzol. That was entirely attributable to the research work of one man. If those things can successfully be done in times of war, I know how many things can be done in times of peace. I have been associated myself with the production of a large number of by-products from coal, and it was even necessary to go to Germany for the bricks and plant in order to erect a certain oven in this country. I satisfied myself that it is possible that these materials can be produced, and ought to be produced, at home, if only we had a sufficient number of research workers and trained men of science turning to practical value their scientific training.

I could go on and develop this subject. I see opposite a representative from Ireland who asked me a question in regard to technical optics, and there is a great deal of work to be done in this country with reference to that subject. A professor told me the other day that it had only just been found out why they were making so many failures. A greenish hue came into the glass they were producing, and in consequence they were unable to produce the necessary lenses. By research work it was found that this was due to barium oxide being contaminated with iron, and they had to go to another source in order to obtain the glass free from this impurity. And so I might go on and give case after case where by

research and a little expenditure on the scientific training of able men we would be able as a country to succeed just in the same way as the Germans have succeeded in recent years. My fear is that after the war we shall have to contend with a fiercer competition than we have had to contend with even in recent years, and it will be conducted by our enemy with less scrupulous methods. The Government agree with me that something ought to be done at once, and we must make more use of the workers in our country and prepare for an increased supply of them, and bring our universities and technical institutions into closer association with industry, and also bring our leaders of industry into closer association with skilled workers. Steps must be taken at once. Adequate supplies require prolonged endeavour. The task immediately before us may be advanced at once by the appointment of an Advisory Council on Industrial Research. I want a Committee of experts who will themselves be able to consult other expert committees working in different directions. They, in turn, must be associated with leaders of industry. We shall want advisers representing various industries in the country who not only possess certain knowledge in connection with pure science, but will be able to turn to the best account the knowledge they have acquired in the application of that knowledge to industry. We shall work in close co-operation with the Board of Trade, who are seconding the efforts of my old board. Such a body as an Advisory Council of very distinguished men upon whom we shall rely for advice, ought to be at work, and I hope it will be at work within the next few weeks. I am now considering the names, although I am not in a position to name them at the moment.

So soon as we get a Committee of that kind nominated they will at once begin their work. The solution of several problems will be placed before them in connection with the glass industry, the making of hard porcelain, technical optics; and it will be one of their duties to secure selected workers who have passed through graduated courses suitable for doing research work in laboratories in the solution of a certain number of definite problems. They will have to advise me as to how money should be immediately spent, and how it should be subsequently spent when we are able to obtain rather larger grants from the Treasury than we shall have at our disposal during the current year. They will have to advise as to the way money should be spent in training and research work generally, and how money should be spent and distributed amongst specialised departments, such as the Imperial College of Science at South Kensington. What I am anxious to secure is the use of the best scientific brains in connection with this enormous problem which is of such vital importance to the country. I hope to place on the Estimates for the current year a sum between 25,000*l.* and 30,000*l.*, but the demand for money for this work will enormously increase as time goes on, and I want to inform the House that whilst we are beginning with this comparatively small sum we think it will develop, and if the scheme is to succeed I believe it must depend upon State help in the years to come, and State help must steadily progress.

As I have been longer in my present post than any of my predecessors, I may be allowed to say that in my judgment two things are essential in the interests of this country if we are to maintain our position and succeed in the future and remain in the proud position, industrially and commercially, in which we are now situated. First, that after the war, and even during the war, an effort should be made to retain longer at school those who are able to benefit by further education. Too many now leave school at the ages of twelve, thirteen, and fourteen, and there is an enormous wastage of ability in the country owing to the non-education of the children after that age. Secondly, the nation should create careers for men who are capable in the scientific world of benefiting that problem. If we had these two things I believe we should maintain our position, and without them I am afraid we shall be discouraged. Therefore, so far as I am able, I wish to appeal to all those men throughout the country who are devoting their lives to the cause of education to do what they can to encourage, not only the longer education of abler children in the secondary schools, but also to make the scheme which I have outlined here this evening very briefly a success in connection with training scientific workers who will be a real advantage to the industries of this country in years to come.

SIR PHILIP MAGNUS: I have no doubt whatever that the scheme for co-ordinating more successfully the science of industry will be welcomed by all scientific men in this country. I should not like it to be thought for one moment that our universities and our technical institutions have failed to turn out a sufficient number of scientifically trained men to be able to carry on research work in connection with our industries almost to the same extent that it has been done in other countries. Where we have to some extent, and to a large extent, failed in this country is in the appreciation of manufacturers and employers of the value and importance of such scientific training, and if the conclusions at which the President has arrived, and if the facts connected with this war will bring home to our manufacturers and employers the great advantage which they can obtain by liberally supporting scientific men in connection with their work, then the Right Hon. gentleman will not have spoken in vain this evening.

There is nothing in which we have been more deficient in this country than in scientific organisation, and, if I may say so, in the organisation of our science, and to this I hope that any such council as he has proposed will diligently apply itself. We have a great number of institutions doing excellent work, but the work of one often overlaps that of another. We want very carefully to see that each institution does that work which it is best fitted to do, and that manufacturers shall have no difficulty whatever in obtaining through any technical or scientific institution the particular class of scientific man which will be helpful in the industry in which they are employed. Take London, for instance. We have already the Imperial College of Science and Technology, on the organisation committee of which I was a member. We have also the Imperial Institute, in which a certain amount of research work is being done of a very high quality in connection with our colleges. We have also, not very far removed, the National Physical Laboratory, where research work is being done, but where more research work might be done if larger funds were available for the purpose. In Berlin there is what is called the Reichsanstalt. That is a research institute which combines the work of our national institute and the National Physical Laboratory, and that institute is placed in close juxtaposition with its Imperial Institute of Science and Technology, which goes by the name of Charlottenburg.

The President of the Board of Education has referred to the fact that it is very difficult to obtain men who will be attracted to the profession of technologists at a salary of 150*l.* a year. I was sorry that he did not remember that the Government itself has advertised for very highly skilled technical chemists at Woolwich at that same salary. I complained of that years ago, but I was told that there was quite a sufficient number of highly skilled chemists only too glad to accept

the position at that small sum. I hope that the Government will be the first to take to heart the lesson which the Right Hon. gentleman has given. There is only one other word I want to say at the present time. I heard with great satisfaction that it is proposed in the scheme to which the President referred that the Board of Trade shall be associated with the Board of Education. I attach great importance to that, because we do not want in this work merely theoretical scientific men. We want men who are imbued with the commercial spirit, and it is desirable that in any body who are to direct instruction by giving suggestions you should combine those who have an intimate knowledge of the trade requirements with those who at the same time are developing the scientific instruction itself. Personally, in the thirty-five years during which I have been associated in, it may be, a feeble endeavour to bring science to some extent to bear upon industry, I have always been most careful to see that the commercial requirements of those engaged in the trade are carefully considered by those who have the task of organising the schemes of instruction. I am glad to see that same policy is likely to be carried out by the President of the Board of Education acting in conjunction with the President of the Board of Trade.

SIR JAMES YOXALL: I think that the Right Hon. gentleman even to-night attached more importance to the highly technical education which has been procurable in Germany under the German system of education than was just. The impression I have been able to form after years of study has been that it is probable that during the last twenty or twenty-five years as many capable men of science, highly skilled chemists and physicists, have been produced by the educational system of this country as has been produced in Germany. My impression is that probably in number, and certainly in quality, even our somewhat unorganised and uncoordinated British system has produced quite sufficient men to provide the industries of this country with sufficient guides, leaders, and captains. The fault has been not with them, or with the schools, colleges, and universities, but, no doubt, with the manufacturers and employers of this country, who have been blind to the opportunities which this material has presented to their hands. Even now, when my Right Hon. friend has created his excellent Advisory Committee, and has used his new grant and has developed further this admirable attempt on the part of the Government to provide for what may happen with regard to industry after the war, little will be the result so long as it is rooted in the minds of employers and capitalists that rule of thumb is better than rule of brain. I would suggest to my Right Hon. friend that he might consider, as a development of what he has submitted to-night, the running of this great concern which he has in view on a commercial basis, so that if manufacturers and capitalists will not take up this work, the State itself should take it up, and provide and sell to the manufacturers the results of researches which otherwise they would not obtain.

MR. ANDERSON: Perhaps the most important matter raised by the President to-night was that of establishing an Advisory Council to deal with matters relating to science and industry, and to bring science into closer touch with industry. That is a very important statement. Personally, I believe that it is along these progressive lines, and not by adopting reactionary policies, that the nation is going to hold its own in regard to industry and trade. We have not in the past spent anything like the amount of money we should have spent in regard to scientific research and technical training. We ought to equip ourselves to the fullest extent along these lines, and it is by doing so rather than by adopting backward policies that we are going to make headway in the future. You ought to try to bring science and industry into closer touch with each other and to make science the great servant of industry, to make it a more practical matter rather than merely be taken up with abstract questions, and you ought to avail yourselves to the fullest extent of the practical knowledge and experience of the working people who are now employed in the factories, in the mills, in the workshops, and so on, and I believe in regard to that, that your Advisory Committee ought to have representatives of labour so as to show that you are going to bring the practical knowledge and experience of the workpeople into account in this matter, and I believe it will be important from the point of view of the success and welfare of your scheme.

MR. LYNCH: Whatever we think of the material aspects of Germany, we really have in her history one of the most extraordinary examples in the whole history of the world of a nation gradually rising to great material power on a foundation of high scientific education. The rise of Germany does not date, as some have said, merely from the great victories in 1870, but from a much earlier epoch when a German with a less salary than the then President of the Board of Education held that office for only two years, and yet within those two years left such a stamp on the education of Germany that it has remained ever since, and has been the real source of the education of the nation—Wilhelm von Humboldt.

Let us consider now one of the questions referred to by the President of the Board of Education to-night, technical education. When we speak of technical education in this country we are too apt to think of trifling details, such as wood carving and filigree work, or such as crewel-work or crocheting impossible parrots on the background of some fancy cloth. In Germany technical education has a very different and a much higher meaning, and having had the advantage of studying in the University of Berlin myself, I can say that one of the most abiding impressions of my whole life was the extraordinary revelation I had there, not merely of the devotion to science itself, but of the manner in which that widened out the whole horizon and prospect of the nation's view, and the way in which science was seen to be the vital influence in great enterprises and wonderful industries. I would not labour this question to-night, but those who have leisure might refer to an article by Sir William Ramsay, first published in NATURE in November, 1914, but to which my attention was called in the French paper *La Revue Scientifique*. The French recognise the value of that article, and in France I think it got wider publicity than in this country. Sir William Ramsay analyses the causes of the greatness of Germany in the industrial world, and he finds several very interesting points which he tabulates. The first is that in a great German industry the board of directors are not a set of ornamental magnates with a peer thrown in to give respectability or publicity, but are a board of specialists on that subject which is the basis of the industry, keen and hard-working men. Secondly, that there is another agency definitely appointed with the definite active functions to watch out for new inventions in other countries. I could enter into this question very deeply, and I could show that right throughout the range of industry there are cases where the real central idea of that industry has not originated in Germany, but in France, England, or America. I believe if I were to ask which is the nation most fertile in ideas and most inventive, from my own brief experience I would be inclined to place the French in inventive genius above even the Americans. The Germans are always

looking out and asking the question, "In what way can we utilise new inventions for the benefit of our own industry?" That forms No. 2 of the points of Sir William Ramsay.

The third is that there is another agency always asking the question as to the cheaper production of the material, not in a passive way, but in an active way; in making inquiries and making voyages to other countries, examining what is done there and exploiting the brains of other men, often covering up the source. That is what the Germans call war. Then comes in the question of protection by the Government. There is a point where the Government could actively intervene to foster industry. Another point not less important is the protection of patents. In many cases Germans have gone so far as to steal the patent from other countries and protect themselves by patents from the other country recovering its ideas. Then there is the propaganda of the excellence of their own products, sending men throughout the world, speaking many languages, active missionaries of the active progress and greatness of Germany. I will cite several industries. The German spirit of organisation is so great that in the most unexpected fields it is exhibited. I remember one of the most prominent mathematicians, M. Picard, of the Institute, who said that though perhaps there had been great names in the history of French mathematics equal to those of the Germans, such as M. Poincaré, who I am proud to have called my friend, who recently died; yet the Germans had pushed their organisation so far that even in that field, so abstruse, they had perfected an organisation for that study.

Take the question of aniline dyes, of which we have heard so much, and which has been the subject of consideration in this House. It is always said in this House, and in the public prints and text-books, that the story of aniline dyes is that a British chemist, Dr. Perkin, discovered and invented a new dye, and that was stolen by the Germans. The matter does not rest in such a passive way at all. Perkin was not, I believe, the first man to produce coloured material from the by-products of coal tar. That was done by Runge some years before. In 1856 Perkin produced his first aniline dye, mauve, and that was considered a great achievement in this country. Already the Germans were beginning that extraordinary organisation of which they are the masters. They seized hold of this, saw its possibilities, and set to work in all the laboratories of that great kingdom, particularly Prussia, and soon produced a whole succession of aniline dyes. They opened up new possibilities, and in this way founded their industry in a perfectly legitimate manner. So that the lack in this country was first a want of appreciation of the value of that discovery, and then the want of active organisation to make use of the discovery when found.

Or take, again, the case of glass, also raised by the President of the Board of Education. The manufacture of glass, of course, has gone on from time immemorial. As a matter of fact, one of the oldest glass manufactories in the world was in what at that time was a Roman colony, Cologne. The most interesting development of the glass industry, however, was, perhaps, the manufacture of optical glass. It arose in this way: A German physicist of great ability, Abbe, noticed that a great deal of the finest microscopical work was robbed of its value by the difficulty of obtaining good optical glass, and so he turned directly away from his own study, sacrificed himself in a certain measure—that is to say, sacrificed his scientific ambitions—upon the altar of the industry of the Fatherland, and devoted his great talents to the study of glass in itself. Being a man of scientific endowment, he speedily discovered what those who had been engaged in the industry before without scientific knowledge might not have discovered in a hundred years in reference to the manufacture of glass. Then came another point which has been raised earlier in the debate. After having reached a certain point, he found that it would be difficult for him to proceed without being sustained financially. He then appealed to the State. The German State was intelligent enough to foster his researches in every possible way, to pay him not merely for his chemical research, but for his endeavour to build up a great industry. So there you have a striking example of the alliance of science with industry, and of State aid supporting both, one which we might very well take to heart. The result was the building up of an industry which imposed itself upon the whole world, and is one of the legitimate glories of Germany to-day. Every medical student who wishes to do his work well is forced to buy a German microscope.

Compare that with the condition of things in this country. I have come down to this House myself in those days when I was more hopeful and I had a real respect for the Government, and I have pleaded for 10,000*l.* for great research work, research work which would have enabled one of the very few men in this country who stand out in the eyes of the whole world as a great figure in modern science, to do most useful work, and I was received with a certain polite indifference and shunted off. I say that, so far from asking 10,000*l.* for research work, I should have been entitled to ask for 10,000,000*l.*—that is to say, if I could ask with sufficient authority—to stimulate in every possible direction the great industries of this country. I go so far as to say that eventually the whole civilisation of this world, and not merely of England itself, must turn on the axis of science, and as we advance we must give proportionately greater and greater importance to this great development of scientific life. When I was a student some years ago of some of these questions, of which I have only given one or two examples out of hundreds which I could expound to the House, I made this extraordinary discovery, that in tracing out the development of science I was really in my own mind proceeding with the development of Humboldt's cosmos. That is to say, that science is the roof of civilisation, and our civilisation is superior to that of the Greeks only in one particular, and that one particular is the advance in positive science. As a result of the advance of positive science our modern civilisation has reached that great expansion which we now recognise.

Then the President spoke about the number of chemists in this country, and said that the number of research students in chemistry is only 350, and yet this country is competing in the commercial world with Germany! I have looked into the organisation in Germany, and I find this astonishing fact: That, in the great chemical works in Germany, for every fifteen men employed in any category whatever there is one highly trained specialist and chemist, and that this industry is so important that there is one highly trained specialist in chemistry for every forty-five employés in any category, right throughout the whole range of industry. When we reach facts like these, are we astonished at the pacific invasion of Germany in every country in the world which, had they been sage enough, would in fifty years have given them a mastery of the world without the cruel and brutal and abominable war which has caused such suffering? But knowing the enormous disparity between one trained chemist for every forty-five employés in all industries, and a total of 350 research students in this country, how are these defects to be remedied? Partly

by giving encouragement to students of science. That is important, but it is not all. I asked a question in this House about the pay of students of chemistry. I find that the War Office itself, which is advertising for students of chemistry, some of them men with degrees, all of them required to do analytical work of a really very difficult kind, such as, after a man obtains his degree in chemistry, would require some special training for at least six months to do the work with the requisite degree of fineness, offered to these men a salary of—100*l.*? There would be nothing preposterous in that. Some of these men are quite qualified to become professors in the great capitals in the Dominions. Was it 500*l.*? It was 100*l.* With what conditions attached? Those men technically were placed on the same footing as ordinary workmen, and they could have been required, had the regulation been enforced, to join in a queue every Saturday to take their 2*l.* at the pay office.

To-day an advance has been notified by the Under-Secretary for War. They are paid 150*l.* Even that is scarcely enough to stimulate men to follow in the path of scientific research. I do not believe that any man who has the true scientific spirit—I appeal to my hon. friend to back me up there—is ever attracted by the mere sake of gain. There is something of the scientific spirit which is almost incompatible with making money. When I read the lives of the great workers of the past I feel indignation even now. Take, for instance, the record of Faraday. The great man, who stands out among the few whose names will be remembered for a thousand years, even after the records of our own Parliament have passed away, as one of the great pioneers of human civilisation; toiled all his life at the stipend of the valet of a peer, and that, remember, in a country where a man's social status and his work, as he calls it, is judged very largely from the amount of salary that he earns.

There will be a revolution when the war is over; a peaceful revolution, if you will, which will be felt right throughout the world, enlarging our education particularly in regard to our technical schools. We do not want the history of the world in text-books given to children at their most susceptible age, which divide history into reigns of kings and queens, most of them utterly worthless, as if the whole philosophy of the world turned on the sanguinary and wretched and often unintelligible accounts of wars and battles. I hope the time will come when we shall have a clearer and saner view of the whole scope and importance of education. It will be more important for the child to know the date at which Oersted discovered the reaction between electricity and magnetism than even to know the date of the battle of Waterloo. There is in science a real spiritual influence—that it to say, the most alluring and fascinating of all the problems which can attract the mind in the gradual unfolding of the meaning of this world itself in which we live. I would like the President of the Board of Education to take his courage in his hands as did Wilhelm von Humboldt in other days; and if he feels himself not strong enough to do this work solus, let him call in the aid of those enthusiastic in the development of science, and the help of those committees of which he has spoken, to carry out their recommendations, not in the half-hearted way in which matters have sometimes been presented in this House, but with something like the missionary zeal of a new evangel. I am certain that when this war is over if the education of this country remains in the condition in which it now is, you may bolster up your military power, you may build *Dreadnought* after *Dreadnought*, but this country will sink. But if this country is to save itself, to regenerate itself, and to proceed on a new path of high development, then the most vital of all problems is that of education.

MR. KING: On this Vote we have had a chorus of approval in favour of greatly increased expenditure on scientific education. I wish to join in that chorus. You cannot have a nation able to benefit by the scientific research and technical instruction and the various facilities for scientific advance which have been foreshadowed to-night unless you have a good foundation in elementary education. If you begin on the same night to cut and curtail elementary education, you are doing an evil turn to advanced research in scientific education. I wish very heartily to congratulate the representatives of the Board of Education upon having shown what is to my mind the first evidence we have had that statesmanlike foresight exists on the Treasury Bench at the present time. We have had plenty of energetic pushing on of the war, but in grasping the issues of what are to come after, and to prepare for the inevitable changes and difficulties and problems which will immediately arise at the end of the war, this is the first inkling we have had that those considerations are present to the mind of the Government. I congratulate the President of the Board of Education and the Parliamentary Secretary to the Board of Education on the scheme they have put forward. I from time to time directed attention, by means of questions and in other ways, to our great deficiency in scientific and technical education, especially with regard to research. Anybody who knows anything about Germany knows the enormous amount of money and the great numbers of men of the highest ability and training and standing engaged in purely scientific research and inquiry.

Everybody who thinks of it and who studies the question must know that Germany's position in the world to-day is due not to the real genius of the people so much as to organisation combined with education, and especially scientific education. I am very pleased that at this time there is an opportunity for an educational advance. I congratulate the members on the Treasury Bench upon their courage and persistence, for I believe it must have needed something of that kind to get this scheme through the Cabinet. I congratulate them on the prospect of having an early Supplementary Estimate. It is true it is only 25,000*l.* I think it ought to be ten times as much, but I have no doubt it is an estimate that will grow. I should like to recall to the members of the Committee the historical references, to my mind of great significance, which we had from the hon. member for West Clare (Mr. Lynch). It was in the year 1809, only two years after the Peace of Tilsit, that Prussia started the University of Berlin. Prussia had been robbed of half its territory by the Peace of Tilsit, which also imposed upon it an enormous indemnity. It had also to support a huge French army of occupation until the indemnity was paid. Yet in that very time Stein and Wilhelm von Humboldt founded the University of Berlin, which has become for its equipment and influence in scientific matters by far the greatest University in the world. They also established at the same time, when the taxes were simply overwhelmingly crushing, the elementary-school system of Prussia, which remains to the present day. I say that a nation that could so appreciate in its hour of ruin the value of education is a lesson to us which we ought to take to heart.

MR. RAWLINSON: I was very glad to hear the President's announcement of the creation of an Advisory Council to deal with this matter, and I need scarcely say that though I have not been able to consult them upon the point, the University of Cambridge, I am sure, will give most unstinted support

to the scheme, such as it is. Whether it will be a success or not will depend upon matters which we cannot discuss to-night. It will depend largely upon the men and upon the methods by which the work is carried out. No one doubts that there is a need for it at the present time. The Right Hon. gentleman has enumerated some of the things in connection with which we have discovered the need, and he could have made a much longer list—things which are vitally important for the carrying on of the war. This country has had brought home to it the recklessness of any island country being dependent for its supplies to a large extent upon places outside its bounds. That is one of the lessons we shall learn from the war. It must be remembered that scientific men have been connected with agriculture and industry in this country before. They were connected with it in the best possible way; they were present while the work was being done. But in one case after the other the Germans bought up those firms and practically carried the industries away to Germany. We must not have that occur again. It is not merely a question of scientific research; it is much more a question of policy. So far as the scientific side is concerned, I think that even the President of the Board of Education was scarcely sufficiently optimistic when speaking of the enormous supply of men in the universities who are perfectly qualified and ready to take part in the industrial side of science. A large number are already doing so, and a very much larger number are perfectly ready and willing to take part and assist in the science of industries of any kind.

DR. ADDISON: There are many things which we must attend to without any delay, and it is for this reason that the Committee for Research will be set up quite soon. A great deal has been done by private effort in respect of research, and notwithstanding all that my hon. friend the Member for West Clare (Mr. Lynch) has pointed out, quite properly, in this connection, I think that the research which has been associated with British men of science has often been the most original of any in the whole world. We have not organised and developed it as we ought to have, but the British researcher is often freer in his outlook and greater in his conceptions, I think, than almost any other. At all events, he certainly stands far above the average German researcher, who tends more to apply the ideas which have been suggested by others, but from all that my hon. friend pointed out we have got to recognise that we cannot afford nowadays to leave all this to private effort. A great deal can be done by careful organisation and by seeing that the men turned out from our universities and technological institutions are equipped with that training which will make them acceptable in industry, and make them more likely to find a good market and a good career for themselves. Going around our institutions you will find certain departments where the professors will tell you that they cannot supply the men quickly enough to the manufacturers, while in other departments it is quite the reverse. The Royal Society has lately, very patriotically, been assisting chemical research in respect of drugs. This was one of the matters in which we felt ourselves behindhand at the beginning of the war. However, I think that my Right Hon. friend may be satisfied with the full assent of the House in all quarters in getting ahead with this great scheme, which, while we hear so much of the mobilisation of our industries with respect to the production of munitions of war, will quickly, for the first time in this country, show that we are going to some extent, at all events, to create a machine which will enable us to mobilise brains and science in the service of industry and national progress.

NOTES.

THE annual visitation of the Royal Observatory at Greenwich will be held on Saturday, June 5.

SIR WILLIAM CROOKES and Prof. R. Meldola have been elected honorary members of the Society of Public Analysts.

WE learn with regret of the death, on May 8, of Dr. P. Zeeman, since 1902 professor of geometry and theoretical mechanics in the University of Leyden.

PROFS. MAURICE CAULLERY (Paris), Charles Henri Marie Flahault (Montpellier), and Jacques Loeb (Chicago) have been elected foreign members of the Linnean Society.

THE London County Council has decided to commemorate the residence of Lord Lister in London by placing a memorial tablet on the house, 12 Park Crescent, Marylebone Road.

WE regret to announce the death on May 13, in his eighty-ninth year, of Dr. M. W. Crofton, F.R.S., formerly professor of mathematics at Queen's College, Galway, and also, later, professor of mathematics and mechanics at the Royal Military Academy, Woolwich.

SIR DAVID BRUCE will this year deliver the Croonian lectures at the Royal College of Physicians of London on June 17, 22, 24, and 29. His subject will be "Trypanosomes causing Disease in Man and Domestic Animals in Central Africa."

AT the annual meeting of the Iron and Steel Institute last week, the Bessemer gold medal of the institute for 1915 was, in the unavoidable absence of the French Ambassador, handed to M. de Fleuriau, councillor of the French Embassy, for transmission to M. Pierre Martin, for his invention of the open-hearth system of steel manufacture.

THE regents of the American College of Surgeons announce the appointment of Dr. J. G. Bowman as director of the college. The college was founded in 1913, and is an organisation of the surgeons of the United States and of Canada, having for its purpose the advancement of the art and science of surgery. The address of the executive offices is 30 North Michigan Avenue, Chicago.

THE trustees of Columbia University, in the city of New York, have awarded the Barnard gold medal to Prof. W. H. Bragg, Cavendish professor of physics in the University of Leeds, and his son, Mr. W. L. Bragg, fellow of Trinity College, Cambridge, and a member of the college staff, at present holding a commission in the Leicestershire R.H.A. (T.F.), for their work on X-rays and crystals. The medal is awarded every five years for "meritorious service to science," on the recommendation of the National Academy of Sciences of the United States. The previous recipients have been Lord Rayleigh and Sir William Ramsay, Prof. von Röntgen, Prof. Henri Becquerel, and Sir Ernest Rutherford.

A PARTIALLY restored skeleton of a small ancestral camel, *Stenomylus hitchcocki*, from the Lower Miocene of Nebraska, U.S.A., has just been added to the

exhibited collection in the geological department of the British Museum (Natural History). The specimen was obtained from Prof. F. B. Loomis, of Amherst College, Mass., who discovered the remains of a herd of these small animals which had been suddenly destroyed and buried by some local accident. As a camel, Stenomylus is remarkable for its extremely slender build, which would render it as agile as a gazelle. It also has molar teeth with unusually deep crowns, so that it would be able to feed on hard and dry grasses. It was therefore more completely adapted for life on open plains and uplands than the other camels which abounded in North America in Oligocene and Miocene times.

THE death is announced in *Science* of Mr. E. W. Morse, formerly instructor in natural history at the Bussey Institution of Harvard University, whose name is associated with his contributions to the history of domesticated animals. Mr. Morse more recently acted as a specialist in animal husbandry in the U.S. Department of Agriculture. In addition to his official duties as an associate editor of the *Experiment Station Record*, and later as an expert in the U.S. Dairy Division, Mr. Morse was instrumental in putting the foundations of animal breeding and feeding on firmer bases. He was an active member of the Biological Society of Washington, the American Society of Animal Nutrition, and the Boston Society of Natural History, and a regular contributor to several standard year-books and encyclopædias.

THE issue of *Science* for May 7 announces the completion of the rebuilding of the Gray Herbarium in connection with Harvard University. The work of enlargement and rebuilding was begun in 1909, and has been carried out a section at a time as the generosity of many benefactors made extension possible. The herbarium dates from 1864, when the late Mr. Nathaniel Thayer gave a building to house the botanical collections which Asa Gray had presented to the University. The primary ideals followed in rebuilding have been those of safety, permanence, and convenience of arrangement, but the elevation of the new structure gives the impression of dignified simplicity and great solidity. During the whole period of reconstruction the herbarium and its library have been open as usual for consultation.

ENGINEERS in many parts of the world will notice with regret that the name of Dr. Fred Stark Pearson appears in the list of those lost in the *Lusitania*. We are indebted to the *Engineer* for May 14 for the following particulars of Dr. Pearson's career. He was widely known on account of the construction of many notable reservoirs for water supply in sub-tropical countries, his first great work of the kind being undertaken in the Republic of Mexico. He became a director of the Puebla Tramway, Light and Power Company, owning five different properties in the Republic of Mexico, and from his long and intimate association with these enterprises he became acquainted with other industrial openings in Latin-America. Gradually he took up interests in concessions, and lent his great talents to the development of many similar enterprises in Mexico, Argentina, Brazil, Paraguay, and Texas. Perhaps Dr. Pearson's most notable enterprise was in connection with the design for, and the construction of, the great hydro-electric station at Necaxa, Mexico, and the construction of a transmission line to a distributing station erected at the city of Mexico, situated some ninety-five miles distant. The success achieved by Dr. Pearson in connection with these Mexican enterprises led to his association with similar projects in different parts of the world, and to his becoming what he at first never intended to be—a company promoter and professional director. In addition to his membership of the American institutions, he was a member of the Institution of Civil Engineers.

By the death of Lieutenant Thomas Wright, who was killed while reconnoitring at night on Sunday, May 2, the staff of the faculty of science at King's College, London, has lost one of its most promising younger men. Mr. Wright studied chemistry under Prof. J. M. Thomson and Prof. Herbert Jackson from 1908 to 1912, completing his course with the associateship of the Institute of Chemistry and first-class honours at the B.Sc. examination. Soon after graduation he was appointed demonstrator in chemistry, and during his short tenure of this post he displayed the greatest energy in teaching science students of all faculties and many races. He came of yeoman stock, and his practical and intimate knowledge of agriculture added to the value of his chemical studies, and although he was not spared to complete any original research, he had already given proofs of an ability, power of observation, and keen insight which would have been of great value at the present time, when the nation so sorely needs numbers of such young men of science. In 1914 Mr. Wright gained an Anglo-German scholarship on the Cassel Foundation, the only one awarded outside Oxford or Cambridge. He was to have proceeded to Germany for further study and research, but the outbreak of war found him under arms as a trooper in King Edward's Horse. He received a commission in the Berkshire Regiment in December, 1914, and was sent out to France in the early spring. As an officer he displayed the same ability, zeal, and initiative which had characterised his all too brief career at King's College. His death means a serious actual loss to his college and potentially to science also, while all who knew him mourn that such a promising life should have passed into silence.

IN *Man* for May, Mr. K. A. C. Cresswell supplements from another field the very interesting paper by Prof. J. L. Myres on the causes of rise and fall in the population of the ancient world (*Eugenics Review*, vol. vii., p. 15), which was practically confined to one field, the Mediterranean. He now extends the survey to Mesopotamia, Persia, and Central Asia. He dwells on the importance of irrigation in the agriculture of these regions, and on the fact that there is historical evidence to show that ages of warfare caused the decay of the canal and karez systems of water supply. He is therefore led to the conclusion that the chief cause of the great fluctuations of the population in these regions has been the collapse of the irrigation system, and that but for this neither war nor mis-

government would have sufficed to bring it about, although Ellsworth Huntington has shown that general desiccation has been a factor. Increase of conserved rainfall follows extension of irrigation, and it is suggested that, the chlorophyll reaction being endothermic, there must be a perceptible lowering of the temperature over large tracts of cultivation. If this is the case, it may possibly have an appreciable effect on condensation.

MESSRS. C. G. SELIGMANN and F. G. Parsons describe, in the Journal of the Royal Anthropological Institute for July–December, 1914, a skeleton found in 1903 at Gough's Cave, Cheddar. It is that of a young adult male whose stature was about 5 ft. 4½ in. It was found in association with implements of the late Palæolithic or Magdalenian period. The cranium shows a fairly close resemblance to that of the River Bed type from whom, in the present state of knowledge, the writers believe the Neolithic people to be descended. There are marked contrasts between the Cheddar skull and two of the Aurignacian age with which the writers are familiar, and though the face and the cranium, except that the latter is long, differ rather markedly from those of the Saxons, the cranium alone could not be distinguished from that of a medieval Englishman. The face and orbits are, however, very different. The conclusion arrived at is that the similarity of the Cheddar and English medieval skulls is not so much a sign of racial affinity, as an indication that among the latter a cranium closely resembling that of the River Bed type had been produced incidentally by numerous crosses.

THE Royal Zoological Society of Dublin is to be congratulated, inasmuch as it possesses the only living gorilla in Europe. But, according to the *Irish Naturalist* for May, their captive has been suffering from a tumour on the right side of the neck and face. A microscopic examination of the pus obtained therefrom showed that the growth was due to actinomycosis. This much having been discovered, it became possible to determine on a suitable course of treatment, which we are glad to note gives promise of success. Having regard to the rarity of gorillas in captivity, and the importance of the results of a study of their habits, it is devoutly to be hoped that a complete cure will be effected.

EXPERIMENTS in acclimatisation should never be undertaken save when they promise to yield some definite and worthy end. But what appears to be a quite harmless venture has been made on Lambay Island, Co. Dublin, where, according to the *Irish Naturalist* for May, more than two thousand reptiles and amphibians have been turned out. For economic reasons Dr. Scharff, the director of the Dublin Museum, now suggests an addition to this number in the diamond-backed terrapin (*Malacoclemmys terrapin*). This species he considers might do well in the harbour, since it lives in North America in salt marshes, feeding on molluscs and crabs. In this event a lucrative "fishery" might in course of time be established, since in America terrapin stew—and champagne sauce—is held in high regard.

Two very interesting articles bearing on the problems of sexual selection will be found in the May number of *Wild Life*. The first, which is all too short, is by Mr. H. B. Macpherson, who describes the "tournament" of the blackcock, illustrating his remarks by some admirable photographs. The second is from the pen of Mr. Edmund Selous, and describes the early breeding habits of the shag. Anything Mr. Selous writes about the courtship of birds is sure to be interesting, and this account of the shag is no exception to the rule. His notes seem to show that, as with the Phalaropes, and some other species, the sexual *rôle* is reversed in the matter of courtship, the advances being made by the female. This being so, the assurance that polyandry prevails with this species is not surprising, though the evidence produced to favour this view is by no means convincing.

THE characteristics of molybdenite are discussed in a short but interesting article in the *Scientific Australian* for March. Since the outbreak of the war the price of this mineral has advanced from 60*l*. to 725*l*. per ton. Happily for us, more than half of the molybdenite ore of the world is obtained in Australia. Though principally used for hardening steel—armour plate containing about 20 per cent. of molybdenite—it is also used for the preservation of certain explosives and as a substitute for tungsten, while the salts of molybdenum furnish a blue pigment used in colouring porcelain and in the dyeing of silk and woollen goods. The normal method of washing the ore proving very wasteful, the experiment of oil flotation is being tried, and promises to effect a great saving. Experiments by the United States Bureau of Mines in smelting molybdenite ores electrically are also being made, and these have shown that ferro-molybdenum, low in carbon, can be made directly from molybdenite in the electric furnace, with excess of lime as a desulphurising agent, and that the sulphur can be readily slagged off as calcium sulphide.

THE appalling rate at which the extermination of the native fauna of Australia is proceeding is tersely told by Mr. W. H. Le Souef in the *Scientific Australian* for March. The ravages of foxes and feral cats, introduced by settlers, is answerable for much of the mischief that has been done. The fox, he remarks, "will in course of time overrun the whole of Australia—it is half over already—and in consequence all ground game . . . will suffer severely." The loss to Australia cannot well be computed in cash, as, besides native game, the fox destroys young lambs, turkeys, geese, ducks, and other domestic poultry. The introduction of the rabbit has proved no less disastrous. The realisation that these agents of destruction need never have been introduced makes the consequences the more deplorable. The inevitable removal of timber and scrub, the drainage of swamps, and the erection of miles of wire fences have proved even more speedy and complete factors of elimination. Wire fences alone have accounted for the deaths of thousands of emus and kangaroos, which are now prevented from making their customary migrations in search of water, and consequently die maddened with thirst. Mr. Le Souef pleads for an

increase in the number of sanctuaries, and we trust his appeal will not fall on deaf ears.

THE British Museum of Natural History and the Zoological Society are both setting a good example in their endeavour to arouse in the public a more lively sense than hitherto of the dangers which beset us, and especially this year, from the flies which invade and infect our food and drink. In the central hall of the Natural History Museum Dr. W. G. Ridewood has displayed a small case containing most realistic models of various kinds of food and drink and kitchen refuse, all of which are being partaken of by hosts of flies. Clearly-worded labels and diagrams enable the visitor to assimilate at a glance the nature of these scourges and the best way to combat them. Prof. H. Maxwell-Lefroy, at the Zoological Gardens, has entered much more fully into the matter, having prepared an exhibition of living flies and their larvæ, supplemented by specimens preserved in spirit, with samples of various kinds of kitchen refuse which serve as a nidus for these pests. Wall diagrams and lantern slides arranged as transparencies, showing the different kinds of flies and the essential details of their anatomy, add materially to the usefulness of this part of the exhibition. Having thus demonstrated the magnitude of this menace to the community, he proceeds to point out various preventive measures by means of fly-traps, poisons, and fumigatories. Specimens of each are ranged around the room, and all have the merit of being at once cheap and easily and safely used by the careful housewife.

THE Journal of the Royal Society of Arts for April 23 contains a paper by Mr. Moreton Frewen on the State and the fisherman. After dealing with instances of successful fish culture by the United States Fish Commission, Mr. Frewen proceeds to consider the marine fisheries of British Columbia. These are very prolific. There are extensive feeding and spawning grounds for herring, cod, halibut, and many other food fishes, while salmon are very abundant in the great rivers. During the last year or so fairly large quantities of North Pacific halibut have been exported to this country. Dealing more particularly with the Charlotte Islands, the author contends that there is, in that area, a magnificent opportunity for fisheries development on a large scale. Railway and harbour developments in recent years seem to solve the problem of profitable distribution of the fish reared, caught, or canned. A large part of the paper is devoted to the consideration of the establishment of fisher-colonies in British Columbia, formed from partially disabled ex-soldiers and ex-sailors, and from those more adventurous men who will return to civil life on the conclusion of the war. Everything, he contends, points to the great commercial development of this part of our overseas dominions, provided that the State may foster, by scientific investigation and well-planned emigration proposals, its great natural resources.

THE water relationship between the soil and the plant has been the subject of numerous investigations, and it has received further attention from Pulling and Livingstone in a publication recently issued from the Carnegie Institution of Washington (No. 204). One of the authors had previously insisted that the power of the soil to deliver water to root surfaces is the prime external condition determining the moisture supply to plants in normal soils. An osmometer was therefore constructed to obtain information on the phenomena involved, and measurements were taken showing the rate at which water passed from the soil into the cell. For this purpose the large end of the thistle funnel was closed with a collodion membrane obtained by evaporation of a solution of Schering's "celloidin" in a mixture of equal parts of alcohol and ether. This membrane, when properly made, was found to be practically impermeable to dissolved substances, although it readily allowed the passage of water. A cane-sugar solution was introduced, and the instrument was buried in the soil with proper precautions to ensure continuous contact. The rate at which water entered was assumed to indicate the power of the soil to deliver water to the root. It is admitted that the phenomena are complex, but the authors urge that in the present stage more good will result from a direct study of the property as such than from any attempt to analyse it into its component factors. Temperature was found to be of great importance in determining the water-supplying power. A critical point was also found which is said to be approximately the same as that observed by other investigators.

ITALY has taken in hand the study of its own glaciers, and its Società per il Progresso delle Scienze publishes the first number of a *Bolletino del Comitato glaciologico italiano* (Rome, 1914, pp. 1–114, with illustrations). This, after a prefatory statement, gives a bibliography of Italian glaciology from 1895 to 1913, and some reports on investigations in 1913. Prof. A. Roccati describes some glaciers in the Maritime Alps, the largest of which begins at 9219 ft. and ends at 8662 ft. This, like other Alpine regions where the summits rarely attain to 10,000 ft., should afford good illustrations of upland valleys from which glaciers have not long disappeared. Prof. F. Porro furnishes a preliminary report on the Italian Miage Glacier, which has long been noted for the size of its moraines and its marked advances and retreats. Prof. D. Sangiorgi describes the glaciers eleven of them considerable, from the Disgrazia to the Monte di Zocca. An easily recognised granite occurs in this mountain group, boulders from which are found even to the south of Como. In the Monte Rosa group Dr. Monterin deals with the Lys Glacier and that of the Val d'Ayas, of which the former, like the Gorner Glacier, is still retreating; and the *Bolletino* ends with studies of two glaciers on the Weisshorn or Corno Bianco (10,893 ft.), a peak on the ridge separating the above-named valleys. Altogether a very promising first number, but we hope that the Comitato will keep in touch with the *Zeitschrift für Gletscherkunde*, for a multiplication of separate periodicals is apt to increase rather than diminish the difficulties of those interested in the history of glaciation.

THE Società per il Progresso delle Scienze publishes in two small parts a summary (Spedizione Asiatica) of the remarkable work done by Dr. Filippo de Filippi in the Karakoram-Himalayas, but as this is even briefer than the accounts which have been already given in the *Geographical Journal*, we may await the volume, which will in due course appear, to supplement the one which described the exploring journeys in which he took part under the leadership of the Duke of the Abruzzi. Evidently Dr. de Filippi with his well-equipped expedition has succeeded, during an expedition lasting about sixteen months, in adding greatly to our knowledge of the physiography and petrology of a region in which Mont Blanc would be an inconsiderable peak.

IN interferometers it has been found convenient to introduce into the path of one of the two interfering beams a plate of plane parallel glass of which the angle of inclination to the beam traversing it could be varied. By this means the optical length of the path could be increased by increasing the inclination of the plate to the path traversed. According to a note by Mr. L. H. Adams, of the U.S. Geophysics Laboratory, published in the Journal of the Washington Academy of Sciences for April 19, a complete theory of the action of such a plate has not previously been available, and he supplies it. A number of important deductions may be made from the theory, one of which is the small effect of the index of refraction of the glass on the sensitiveness of the plate as a compensator.

A RECENT paper by Mr. W. Calder on oil-well engineering, read before the Institution of Petroleum Technologists on April 30, is well worthy of the attention of all interested in this highly specialised branch of engineering, and perhaps especially of young men who may be intending to devote themselves to this particular department. In this country, where no practical experience in oil-well technology can be obtained, there is perhaps too great a tendency to regard the subject almost exclusively from the geological viewpoint, and this paper comes opportunely to lay emphasis upon the engineering aspect of the work. It makes it very clear that, although for the location of the borehole the services of the geologist are indispensable, yet all the subsequent work depends for its success upon the engineering abilities of the man in charge. Well-drilling is purely a matter of mechanical engineering, and requires for its successful execution not only a thorough mechanical training, but an amount of resourcefulness and ingenuity that can never be acquired unless by men in whom the engineering instinct is innate. Mr. Calder's paper brings the whole subject well up to date, and describes a number of the most modern drilling devices, which, though quite familiar to oil-well engineers, are by no means adequately dealt with in the general literature of the subject; it is therefore an exceedingly useful contribution to oil-well technology.

THE twin sciences of heating and ventilation have received little attention in their scientific aspects. In a paper read before the Society of Engineers on May 11, Mr. A. H. Barker dealt with a few of the difficulties of these subjects. He pointed out that physiologists are not even agreed upon what was a healthy temperature for human beings to live in. The heating and ventilating engineer aims at producing comfort, but is baffled by the fact that a man is comfortable only when he thinks he is. Air which, judged by chemical analysis, is impure, may feel fresh and sweet, and *vice versa*. The only legitimate function of the engineer is to produce and control specified movements of air and other effects, while it should be the duty of the physiologist and hygienist to specify what are healthy and comfortable conditions. In connection with heating, the expression "temperature of a room" is generally understood to mean the reading of a thermometer suspended in the room, but this reading does not necessarily indicate the temperature of the surrounding air, or form a trustworthy guide to the feelings of the occupants of the room. The air temperature, the radiant temperature, the quantity of convected heat and the quantity of radiant heat must all be determined, but first the relation between the thermometer reading, the air temperature, and the radiant temperature must be determined. The freshness of air in a building depends on keeping the air temperature relatively low and the radiant temperature high. The chemical composition of the air has, within wide limits, no effect on the human organism, whereas its temperature and humidity are very important. The paper described experiments made at University College, London, and the apparatus used in connection with them, and discussed briefly some problems which it is sought to solve experimentally.

A PAPER on the distribution of heat in the cylinder of a gas engine was read before the Institution of Mechanical Engineers on May 14, by Prof. A. H. Gibson and Mr. W. J. Walker. The paper gives account of a series of tests made at University College, Dundee, in order to determine the jacket loss at different speeds. The engine, built by the National Gas Engine Co., Ltd., has a cylinder diameter of 11 in., and a stroke of 19 in. The water jacket is divided into two separate parts, one of which surrounds the exhaust-valve, and the other surrounds the breech-end and barrel of the cylinder. With the strongest mixture, and at full load, the percentage heat transmitted to the cylinder jacket is 1·10 times as great at 150 revs. per min. as at 250 revs. per min., while with the weakest mixture the ratio becomes 1·23. At 150 revs. per min. the period of contact per cycle, of hot gases and cylinder walls, is 1·66 times as great as at 250 revs. per min., and the rate of transmission of heat is evidently much greater at the highest speed. The indicator diagrams show that the maximum temperature attained in the cylinder is approximately 6 per cent. greater at 150 than at 250 revs. per min., so that the increased rate of transmission is obtained in spite of a lower gas temperature. The reason lies apparently in the fact that the greater turbulence of the working fluid at the higher speeds increases its effective conductivity to an extent which more than counterbalances the other factors.

OUR ASTRONOMICAL COLUMN.

COMET 1915*a* (MELLISH).—Although Mellish's comet is brightening up, its large and increasing southern declination does not make it an easy object to observe in these latitudes. For the sake of those observers who are more favourably situated the following ephemeris, communicated by J. Fischer-Petersen (*Astronomische Nachrichten*, No. 4796), gives the positions up to June 5, when the comet attains its maximum brilliancy.

	R.A. (true) h. m. s.	Dec. (true) ° ′	Mag.
May 22 ...	19 33 42 ...	−35 12·3	
24 ...	19 42 22 ...	39 15·4 ...	5·3
26 ...	19 52 49 ...	43 41·9	
28 ...	20 5 50 ...	48 27·7 ...	5·0
30 ...	20 22 30 ...	53 29·7	
June 1 ...	20 45 ...	58 38 ...	4·8
5 ...	21 57 ...	−68 10 ...	4·7

In an appendix to No. 4800 of the *Astronomische Nachrichten* a telephone message to the Computing Bureau is reported from Prof. R. Schorr, stating that the nucleus of this comet has become divided into two parts, their magnitudes being 11 and 13, distance 20″, and position angle 291°. This fact was recorded on photographs taken by Dr. H. Thiele with the reflecting telescope of the Bergedorf Observatory.

PHOTOGRAPHIC DETERMINATIONS OF STELLAR PARALLAX.—With the hope of making more accurate determinations of stellar parallax by means of photography, Mr. Adriaan van Maanen has been utilising the 60-in. reflector of the Mount Wilson Solar Observatory for this purpose. At present he has only completed the discussion of fine stars, and these promising results are briefly described in the Proceedings of the National Academy of Sciences (April 15, vol. i., No. 4). The following table gives the names of the stars, the parallaxes derived, the probable errors, and the number of exposures :—

	Star	Parallax ″	Prob. error ″	No. of exposures
Boss P.G.C.	96	+0·026	0·007	14
	672	−0·009	0·004	14
	1549	+0·001	0·001	16
	2921	+0·078	0·006	10
	3233	+0·003	0·010	12

Mr. van Maanen states that the mean probable error of a parallax for the mean of thirteen exposures is not quite 0·006″, and "if we compare this result with the best-known photographic determinations of parallaxes . . . it will be seen that we have gained considerably." He gives a list of these best-known parallaxes showing the mean probable errors in each case. Thus the four least probable errors from this list are as follows :—

Instrument	Observer	Mean prob. error ″	No. of exposures
Yerkes (40 in.)... ...	{Slocum / Mitchell	... 0·009	... 28
Yerkes (40 in.) ...	,,	... 0·011	... 21
Swarthmore (24 in.)...	Miller	... 0·011	... ?
Yerkes (40 in.)... ...	Schlesinger...	0·013	... 37

REPORT OF THE KODAIKANAL AND MADRAS OBSERVATORIES.—The annual report of the director, Mr. J. Evershed, of the Kodaikanal and Madras Observatories, for the year 1914, has just come to hand. Reference is made in the first place to the expedition to Kashmir to test the suitability of the climate for solar research, the result of which was recorded in this column on December 24 last. A long list is given of the instruments belonging to the observatory, which list includes the instruments received from the Takhtasinghji Observatory at Poona. During the year a positive on negative spectrum comparator, constructed by Messrs. Hilger from designs by the director, was received, and also a diffraction grating ruled by Anderson, with ruled surface 9·7 × 12·8 cm., and total number of lines 75,085. This grating was immediately mounted in the large spectrograph, and "is the most perfect the observatory possesses, and it is now used in all researches where high resolving power is required." The work accomplished by the various instruments is next described. Under the heading of the spectroheliograph it is stated that the measures made from spectroheliograms will in future replace detailed observation at the telescope of the position angles and heights of the prominences. Summaries of sun-spot and prominence observations are given, showing that the solar activity was at a minimum in 1913. Eleven bulletins were published during the year. The report of the Madras Observatory describes the time observations and a general account of weather summary. The appendices contain tables of the seismic records at Kodaikanal and meteorological observations at both Kodaikanal and Madras.

ASTRONOMY AT HAMPSTEAD.—In the year 1899 the Hampstead Scientific Society was promoted for the study and encouragement of a popular interest in science, and at the present time there are three special sections of the society, namely, astronomical, natural history, and photographic. The report for the past year gives one a good account of the activity of the society, but, like many other societies, the disturbing influence of the war has been responsible for a smaller output of work. During the latter part of the year the enforced closing of the observatory rendered any observations impossible, but the attendance of members at the meetings fortunately did not suffer. The report of the astronomical section refers to the observational and theoretical work in connection with the planet Saturn, the new subsection of lunar detail, and the eclipse of the sun in August last. Brief accounts are given of the papers read at the meetings.

RECENT WORK IN APPLIED BIOLOGY.

TWO recent numbers of the *Journal of Economic Biology* (vol. ix., 3, 4, 1914) contain an interesting article on the biology of sewage disposal, by J. W. Haigh Johnson, who points out that in sewage filters "the varying intensity of pollution between the crude sewage and the purified effluent would provide suitable conditions for the development of a range of organisms." The flora consists mostly of bacteria such as *Bacillus coli*, Zooglœa, and such fungi as Saprolegnia and Sporotrichum. On these feed larvæ of small hairy flies belonging to the genus Psychoda, which often swarm around sewage outfalls. Enormous numbers of the small blue-black springtail *Achorutes viaticus* form a characteristic and interesting feature on the surface of the liquid.

In the *Journal of Agricultural Research*, published by the United States Department of Agriculture, valuable biological papers constantly appear. In vol. ii., No. 6, E. O. G. Kelly describes a new sarcophagid parasite of grasshoppers. The female Sarcophaga "strikes" at the grasshoppers (species of Melanoplus and Schistocera) when flying, causing them to drop to the ground. She deposits tiny active maggots beneath the grasshopper's hind-wing. Thence they crawl to the metathorax and enter the victim's body through the soft cuticle at the wing-base.

The same number of the *Journal* contains an account, by F. Knab and W. W. Yothers, of *Toxotrypana curvicauda*, the "Papaya fruit-fly," the female of which, by means of an ovipositor as long as her

body, lays eggs deep in the unripe fruit of the Papaya, where the maggots find an abundant and congenial food-supply. This mode of feeding, as is well known, is practised in oranges, lemons, peaches, etc., by larvæ of the notorious "Mediterranean fruit-fly" (*Ceratitis capitata*), which forms the subject of two papers in the *Journal* (vol. iii., Nos. 4 and 5), by E. A. Back and C. E. Pemberton. This fly is now a serious pest in the Hawaian Islands, though it has not yet been introduced into the United States. Attempts are being made to introduce parasitic and predaceous insects that may keep the fruit-fly in check, and one of the papers just mentioned deals with this aspect of the question. Prof. F. Silvestri made last year a special journey to West Africa in order to study the natural enemies of fruit-flies, the results of which are described in the *Boll. Lab. Zool. Scuola Agric. Portici* (vol. v., 1914). Here may be found diagnoses with structural figures of a number of the destructive flies and of insects which prey on them, most of the latter being small Hymenoptera.

Our own *Bulletin of Entom. Research* maintains the high standard of its systematic and economic papers. In vol. v., pt. 3, lately issued, Dr. W. A. Lamborn's account of agricultural pests in Southern Nigeria opens new ground, and is well illustrated with a coloured plate of Lepidoptera and several photographs of injured plants. Stanley Hirst describes mites—mostly Dermanyssus and other Gamasidæ—found on rats in Egypt; while Rev. Jas. Waterston, turning for a while from Mallophaga, gives an account, with interesting structural figures, of new Chalcidoid fig-insects from Uganda. In the March number (vol. v., No. 4), just received, Mr. Waterston describes a number of parasitic Chalcidoids from tropical Africa and members of the same group from Ceylon. Among several useful papers in this number, S. A. Neave's account of the Tabanidæ of Southern Nyasaland, with descriptions of the early stages and bionomics of the species, is noteworthy. The *Review of Applied Entomology* is continued monthly, and contains excellent summaries of papers published in all parts of the world, agricultural entomology being contained in Series A, medical and veterinary subjects in Series B. In placing these publications within the reach of all students, the Imperial Bureau of Entomology abundantly justifies its existence. G. H. C.

MINERAL RESOURCES OF THE PHILIPPINE ISLANDS.

THE annual report upon the mineral resources of the Philippine Islands for the year 1913 has just been issued at Manila by the Division of Mines of the Government of the Philippine Islands. It gives evidence of fairly steady progress in the development of the mineral resources of these islands under American auspices. The value of the mineral production is estimated at just about 400,000*l*., an increase of about 14 per cent. above that of 1912, but it must be remembered that these figures are made up, in accordance with the usual practice of the United States, from a number of items that are not generally included in the mineral statistics of other nations, such items as clay products, sand and gravel, and lime accounting for fully one-fourth of the total value. It is noteworthy that no coal was produced in the year under review, whereas the output for the year previous had been 2700 tons; there seems to be no good reason for this complete cessation of coal mining; it is true that one of the mines that had produced coal in 1912 had been drowned out apparently through careless driving into broken ground, which seems not to have been properly tested before the drift in question was put in.

Nearly one-half of the total value of the mineral output is due to the production of gold, of which 42,011 ounces were obtained, both quartz mines and alluvial mines having contributed to the total. The increase of production over 1912, when 27,582 ounces were produced, is relatively important; it is mainly due to dredging operations in the Pasacale district, where five dredges were at work, and where three additional ones were being constructed; it appears that the alluvial deposits are quite satisfactory, but that a shortage in the fuel supply, which appears hitherto to have been wood exclusively, threatens to become a serious problem in the near future.

The output of iron, in the form of castings direct from small native blast-furnaces, amounts to 227 tons, an increase of practically 50 per cent. above that in 1912. These castings are almost exclusively ploughshares; they were produced in ten furnaces, each of which averaged sixty-six days in blast throughout the year; they consumed 555 tons of 60 per cent. ore and 960 tons of charcoal, the iron extracted being thus just about two-thirds of the total iron present. It is interesting to note that this primitive method of iron-smelting is still able to hold its own in the face of imports of iron more than ten times as great as the total native production.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

BRISTOL.—The University has been concerned since its foundation with the question of residential accommodation for its students. Early in its history it received an important benefaction for the accommodation of women students in the shape of Clifton Hill House, to which the adjoining Callander House has since been added. During the past year the Imperial Hotel and a large property on Richmond Hill, Clifton, have been purchased for conversion into halls of residence for men and women training students. The University has now taken two houses for the purpose of a temporary residential college for men students. These houses are being renovated and decorated, and will be opened in good time for next term. When the arrangements are complete, the temporary college will start with accommodation for twenty-nine students.

GLASGOW.—His Majesty in Council has approved the Ordinance of the University Court, empowering the University to establish a degree of bachelor of science in applied chemistry. In conjunction with the Royal Technical College, which is affiliated to the University, courses in the various branches of chemistry relating to a wide range of arts and industries will be provided. The curriculum extends above four years, and the examinations will be of an honours standard.

More than 140 students in arts, law, and pure science have volunteered for service in the munition factories during the summer vacation. Arrangements have been made by the Appointments Committee with a number of firms on the Clyde, which are prepared to give employment of the kind to students who are not eligible for active service with the forces. When the sessional examinations are completed at the beginning of June, it is expected that at least 100 more students will undertake similar work.

LONDON.—A new edition of the University College "Pro Patria" is in course of preparation, and will be issued shortly. Past and present students, or their relatives and friends on their behalf, are invited to send full particulars of the capacity in which they are serving the country at the present time. In the case of the Army, rank and regiment should be given; in

the case of the Navy, rank and ship. These particulars should be addressed to the Publications Secretary, University College, London (Gower Street, W.C.).

OXFORD.—The Halley Lecture will be delivered on May 20 at 8.45 p.m., in the hall of Queen's College, by Sir Frank W. Dyson, F.R.S., Astronomer Royal. The subject of the lecture, which will be illustrated with lantern-slides, is "The Measurement of the Distances of the Stars."

THE Year Book Press, 31 Museum Street, London, has been appointed by the Teachers' Registration Council as publishers of the first "Official List of Registered Teachers," which will be issued as soon as arrangements have been completed.

IN the issue of *Science* for May 7 it is announced that Mr. Andrew Carnegie's gifts to the Carnegie Institute and Institute of Technology—both at Pittsburgh—have now reached a total of 5,400,000*l*., his latest contribution, announced on April 29, being 540,000*l*. Of this latter amount 240,000*l*. is for new buildings, and 300,000*l*. for endowment. From the same source we learn that the campaign to raise 277,000*l*. for the Stevens Institute of Technology in Hoboken, N.J., has been concluded successfully. The entire indebtedness of the college, amounting to 77,000*l*., has been cancelled, leaving 200,000*l*. to be used for the erection of new buildings and for endowment. Gifts amounting to 14,580*l*., to be devoted to cancer research at the Harvard Medical School, have been announced. Of this sum 10,000*l*. is provided by the will of the late Mr. Philip C. Lockwood, of Boston. The legislature of Nebraska has granted 30,000*l*. for the erection of a teaching hospital for the University of Nebraska College of Medicine at Omaha, Nebraska.

THE Board of Education has issued a table of summer courses in England for instruction in many of the subjects of the school curriculum. The courses will be held on various dates during July, August, and September next. Nature-study appears to be one of the most popular subjects, and courses in it are being arranged at Ambleside, Bingley, Brighton, Falmouth, Great Yarmouth, Scarborough, Glastonbury, Newport, and Swanley. Geography, too, seems to be in great demand, probably in view of the growing popularity of practical methods of teaching the subject. Geographical courses are being held at Ambleside, Brighton, Cambridge, Oxford, and Sheffield. Courses in science will be held at Oxford, Wye, and Bangor, and at five centres there will be lectures on the theory of education. The official table states the authorities responsible for the courses, dates, fees, subjects of instruction, addresses for further particulars, and gives useful general remarks. Copies can be obtained through booksellers at a cost of one penny each. The war will reduce the facilities for foreign travel, and teachers who desire to combine further study with their recreation during the long vacation should study this pamphlet.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, May 13.—Sir William Crookes, president, in the chair.—Elizabeth A. **Fraser** and Prof. J. P. **Hill**: The development of the thymus, epithelial bodies and thyroid in the vulpine phalanger (*Trichosurus vulpecula*).—Elizabeth A. **Fraser**: Some observations on the development of the thymus, epithelial bodies, and thyroid in Phascolarctos, Phascolomys, and Perameles.—J. H. **Brinkworth**: Measurement of the specific heat of steam at atmospheric pressure and 104·5° C., with a preface by Prof. H. L. Callendar. The measurement of the specific heat of steam in the immediate neighbourhood of 100° C. permits extreme steadiness in the conditions of observation, and is important as the starting point for the investigation of the variation of the specific heat with pressure and temperature, but presents special difficulties owing to the possible presence of water in suspension when the superheat is very small. The majority of determinations, such as those of Regnault (125°–225° C.), and Holborn and Henning (110°–270° C.), have been made with highly superheated steam, and throw little light on the value near 100° C. Those of Knoblauch and Jacob, and Knoblauch and H. Mollier, when extrapolated towards saturation, appear to indicate a very rapid increase in specific heat near the saturation point. The theory of the variation of specific heat with pressure is discussed in the preface in relation to some experiments by the Joule-Thomson method, the results of which were published in a previous communication. It is shown that the presence of only half-a-millionth of a gram-molecule of salt per gram of steam is sufficient to raise the apparent specific heat by 10 per cent. at 103° C., and that previous measurements near saturation were probably affected to a slight extent by this source of error. Special precautions were taken in the investigation to secure pure dry steam, and the conditions of experiment were varied widely, especially with regard to external heat-loss. By using a silvered jacket of silica maintained at a high vacuum, the loss was reduced to about a tenth of that in previous experiments, and amounted to only two or three parts in 1000 of electric energy supplied. The final result found was—$S = 2030$ joules per gram per 1° C., at 760 mm. and 104·5° C., which is equivalent to 0·485 mean calorie under the same conditions, and is in good agreement with Regnault's result at 175° C., if allowance is made for the small variation deduced from the experiments by the throttling method.—C. F. **Jenkin** and D. R. **Pye**: Thermal properties of carbonic acid at low temperatures.—II. This is a continuation of the paper on the same subject published in the *Phil. Trans.*, A, vol. ccxviii., p. 67. It contains a description of (1) a series of measurements of the total heat of CO_2 gas from which the specific heats are deduced; (2) a few re-measurements of the total heat of liquid CO_2; and (3) a series of throttling experiments on CO_2 gas. By means of the first series the $\theta\phi$ chart, part of which was drawn in the former paper, is extended over the superheated gas area; its accuracy is then checked by means of the throttling experiments. Graphic methods are described for plotting the results of throttling experiments and thereby checking the specific heats of the gas and position of the gas-limit curve. Finally, an $I\phi$ chart is constructed for CO_2 based on the measurements described in both papers. To assist in the construction of this chart, a series of theorems connecting the total heat I with the other variables p, v, θ, and ϕ are worked out, and their use in checking the accuracy of $I\phi$ charts for any substances is explained. The authors hope that the new $I\phi$ for CO_2 chart, which extends and corrects Mollier's, may be of some technical value in the refrigeration industry.

Physical Society, April 23.—Dr. A. Russell, vice-president, in the chair.—Prof. W. B. **Morton** and Miss Mary **Darragh**: The theories of Voigt and Everett regarding the origin of combination tones. Voigt connects the existence of difference and summation tones with the fact that the stationary points of the compound vibration-curve, when the primary tones have equal energies, can be grouped in a certain way on sine curves, which recur in the periods of these combination tones. As against this view it is urged (1) that the same points can equally well be grouped on a

whole series of curves with other frequencies; (2) that the distinctness of the combination-tones would on this theory vary greatly with phase-relationship of the primaries; (3) that the tones would disappear when the energies of the primaries are not very unequal. Voigt applies a similar method to the case where the upper tone is weak compared to the lower to account for Koenig's second beat-tone. The first of the above objections again applies. Everett supposed that the distortion of the vibration-curve in passing through the ear would bring in the note the frequency of which is the highest common factor of the primary frequencies. The effect of a special kind of distortion has been tested, consisting in a proportional reduction of ordinates in one direction. The result does not confirm Everett's contention, but shows the appearance of the summation and difference tones.—Miss Maud **Saltmarsh**: Experiments on condensation nuclei produced in gases by ultra-violet light. (1) Nuclei produced in air by ultra-violet light which has traversed a few centimetres of air are not affected by an electric field of 50 volts per centimetre. (2) The nuclei are equally effective in producing condensation of water, toluol, and turpentine vapours, and they are formed even by light which has traversed 50 cm. of air. (3) Alcohol vapour condenses without expansion on much smaller nuclei than does water vapour. (4) No nuclei were formed by the light unless oxygen or CO_2 was present in the gas. (5) No trace of H_2O_2 could be detected in the clouds formed on the nuclei. (6) Oxygen containing ozone also contains nuclei for condensation, and these nuclei have similar properties to those formed by ultra-violet light. (7) The nuclei can be destroyed by heating the air containing them. It seems probable that the nuclei formed by ultra-violet light do not cause condensation by virtue of any particular chemical composition, but that they are particles large enough to act like dust particles as centres round which condensation can begin.—S. **Butterworth**: The self-induction of solenoids of appreciable winding depth. The existing formulæ for coils of this type—viz., those of Rosa and Cohen—are shown to be inaccurate, the error amounting to one-fifth of 1 per cent. for the best formula when the winding depth is one-tenth the diameter of the coil. For greater winding depths the error is larger. The inaccuracy in Rosa's formula is due to the neglect of curvature in correcting for thickness, while in Cohen's formula the error is due to the approximate method of development. New formulæ are developed by methods which are free from such approximations, and which apply to any coil for which the length is greater than twice the diameter, and the winding depth is less than one-tenth the diameter. These formulæ are capable of giving eight-figure accuracy. Simplified formulæ are also given which are suitable when only four-figure accuracy is required.

Mathematical Society, May 13.—Sir Joseph Larmor, president, in the chair.—Dr. **Bromwich**: The diffraction of waves (i) by a wedge, (ii) by a circular disc.—W. E. H. **Berwick**: An invariant modular equation of the fifth order.—G. B. **Mathews**: A direct method in the multiplication theory of the lemniscate function.

MANCHESTER.

Literary and Philosophical Society, April 27.—Mr. F. Nicholson, president, in the chair.—Prof. W. H. **Lang**: Studies in the morphology of Isoëtes:—Part iii., The structure and growth of the rhizophoric region of *I. lacustris*, and the development and arrangement of the roots. Part iv., The progressive growth of the young plant of *I. lacustris*, and the nature of the cortical extension of the stock. In part iii. the structure of the rhizophoric lower region of the stock of *I. lacustris*; the nature of its meristematic growth; the way in which the segmentation of the growing line leads to the growth of a root-bearing surface, exposed by the progressive splitting, and to the carriage outwards of the roots initiated close to the meristem are described in detail. The organisation of the central vascular axis of the rhizophore behind the meristematic line is shown to correspond remarkably to that of the stem-stele as described in part ii. The arrangement of the roots, their exogenous insertion, and the course of the root-traces are compared with the corresponding features of Stigmaria. In part iv., the progressive growth and organisation of the young plants of *I. lacustris* are traced from the stage of an advanced embryo to that at which a small plant exhibits adult characters as regards root- and leaf-arrangement. The symmetry of the plant is only evident when the second leaf and second root are developed. Further roots arise from a meristem established at the base of the vascular axis of the shoot long before any cambial activity has begun. The rhizophore continues from this meristem as a region of progressive growth, bearing roots acropetally. It may correspond strictly to the root-bearing region in Lepidodendreæ. The primary root in Isoëtes is lateral to the axis of the rhizophore; the construction of the plant thus appears fundamentally distinct from the Gymnosperms and Angiosperms, where the first root continues the axis of the plant and behaves as a tap-root. The progressive cortical growth of the young plants of Isoëtes appears to continue uninterruptedly into that of the adult stock.

May 11.—Prof. S. J. Hickson, president, in the chair.—Dr. Arthur **Harden**, Prof. W. W. Haldane **Gee**, and Dr. H. F. **Coward**: A report on the Dalton diagrams. A report on a collection of about 150 original pen-and-ink diagrams used by John Dalton. They describe the elementary principles of mechanics, heat, optics, and astronomy; the laws of expansion by heat; the special scale of temperature used by Dalton; meteorological subjects; and chemistry and the atomic theory. The diagrams dealing with the atomic theory show that Dalton used graphic formulæ for "compound atoms" much more frequently than would be suspected from a study of his printed books or note-books. Many sheets illustrate the atomic composition of inorganic and organic substances. The latter are almost completely ignored in Dalton's published works, and in consequence his representation of them would be unknown at the present time were it not for the information disclosed by these diagrams. The formulæ are, however, very different from those now accepted. One of the diagrams is a list of atomic weights and symbols made in 1807, and is, so far as is known, the second list presented in public by him.

PARIS

Academy of Sciences, May 10.—M. Ed. Perrier in the chair.—E. **Bompiani**: The equations of Laplace with equal invariants.—G. H. **Hardy**: The problem of divisors of Dirichlet.—Et. **Delassus**: The holonomial movements with multiple forms of Bagrange.—G. **Chesneau**: Contribution to the study of coloured glass of the Middle Ages. Analyses of violet, blue, green, and red glass, dating from the end of the thirteenth century, from Rheims Cathedral. The oxides of copper, nickel, cobalt, manganese, and iron were used as the colouring materials.—J. **Bougault**: The dioxytriazines. The synthesis of substituted semicarbazides. A method for preparing asymmetrical dioxytriazines has been given in a previous paper. These behave as acids towards alcohols, and give mono- and di-ethers in which the alkyl group is attached to nitrogen. The mono-alkylbenzyldioxytriazine on hydrolysis with boiling alkaline carbonate solution gives the alkyl-semicarbazone of phenylpyruvic acid, and this, treated

in the cold with strong hydrochloric acid, gives the chlorohydrate of the alkylsemicarbazide. The method appears to be general, and descriptions are given of methyl-, benzyl-, and ethyl-semicarbazides.—Œchsner de **Coninck** and M. **Gerard**: Some basic salicylates.—Amé **Pictet** and Maurice **Bouvier**: The saturated hydrocarbons of vacuum tar. The raw material for this work consisted of 60 kilograms of tar distilled from one and a half tons of coal under a pressure of 15 to 20 mm. The unsaturated hydrocarbons were separated by means of liquid sulphur dioxide instead of with fuming sulphuric acid, as in the preceding note on the same subject. Six saturated hydrocarbons have been isolated, two being identified with certainty as hexahydrodurene and hexahydromesitylene, and the remainder are probably homologues of *cyclo*hexane. The same hydrocarbons have been isolated by Mabery from Canadian and Californian petroleums.—G. **Murgoci**: Rhodusite and abriachanite. These two minerals are the extreme ferric terms of the glaucophane series.—Const. A. **Kténas**: The iron minerals of igneous origin of eastern Greece and their transformations.—Stanislas **Meunier**: Mechanical phenomena as a factor in the elaboration of crystalline rocks.—N. **Arabu**: Studies on the Tertiary formations of the basin of the Sea of Marmora. The distribution of the faces in the different stages of the Tertiary; sketch of the tectonic of that region.—J. **Deprat**: The intermediate folded zones between Yunnan and Haut-Tonkin.—Eugène **Pittard**: Comparative anthropometry of the Balkan peoples.

BOOKS RECEIVED.

Evolution and the War. By Dr. P. C. Mitchell. Pp. xxv+114. (London: J. Murray.) 2*s*. 6*d*. net.

Life-Histories of African Game Animals. By T. Roosevelt and E. Heller. Two vols. Vol. i. Pp. xxviii+420. Vol. ii. Pp. x+421–798. (London: J. Murray.) 42*s*. net.

Brazil (1913). By J. C. Oakenfull. Pp. viii+604. (Frome: Butler and Tanner.) 7*s*. 6*d*. net.

Annuaire Général de Madagascar et Dependances (Supplément à l'Annuaire 1914). (Tananarive: Imprimerie Officielle.)

The Body in Health. By Prof. M. V. O'Shea and J. H. Kellogg. Pp. ix+324. (New York: The Macmillan Company; London: Macmillan and Co., Ltd.) 3*s*. 6*d*.

The Magic of Experience. By H. S. Redgrove. Pp. xv+111. (London: J. M. Dent and Sons, Ltd.) 2*s*. 6*d*. net.

The World's Cotton Crops. By Prof. J. A. Todd. Pp. xiii+460. (London: A. and C. Black, Ltd.) 10*s*. net.

Short English Poems for Repetition. By C. M. Rice. Pp. xv+119. (Cambridge: W. Heffer and Sons, Ltd.) 1*s*. 3*d*.

Elements of Optics for the Use of Schools and Colleges. By G. W. Parker. Pp. 122. (London: Longmans and Co.) 2*s*. 6*d*.

Symbiogenesis. By H. Reinheimer. Pp. xxiii+425. (Knapp, Drewett and Sons, Ltd.) 10*s*. 6*d*. net.

DIARY OF SOCIETIES.

THURSDAY, MAY 20.

ROYAL SOCIETY, at 4.30.—The Corpuscular Radiation Liberated in Vapours by Homogeneous X-Radiation: H. Moore.—The Absorption in Lead of γ Rays Emitted by Radium B and Radium C: H. Richardson.—The Application of Interference Methods to the Study of the Origin of Certain Spectrum Lines: T. R. Merton.

ROYAL INSTITUTION, at 3.—The Movements and Activities of Plants: Prof. H. Blackman.

INSTITUTION OF MINING AND METALLURGY, at 8.—The Physical Condition of Cassiterite in Cornish Mill Products: the late J. J. Beringer.—Note on the Concentration of Gold in Bottoms in the Converter: H. F. Collins.—The Morro Velho Method of Assay of Gold-Bearing Cyanide Solutions: D. M. Levy and H. Jones.—The Effect of Different Methods of Crushing on the Ash of Coke: F. A. Eastaugh.

AERONAUTICAL SOCIETY, at 8.30.—Wilbur Wright Memorial Lecture—The Rigid Dynamics of Circling Flight: Prof. G. H. Bryan.

FRIDAY, MAY 21.

ROYAL INSTITUTION, at 9.—Beauty, Design, and Purpose in Foraminifera: E. Heron-Allen.

SATURDAY, MAY 22.

ROYAL INSTITUTION, at 3.—Colouring Matters of Nature: Dr. M. O. Forster.

TUESDAY, MAY 25.

ROYAL INSTITUTION, at 3.—Dyes, the Creation of the Chemist: Dr. M. O. Forster.

ZOOLOGICAL SOCIETY, at 5.30.—A Blood-sucking Gamasid Mite parasitic on Couper's Snake: S. Hirst.—A List of the Snakes of Madagascar, Comoro, Mascarenes and Seychelles: G. A. Boulenger.—Anatomical Notes on the Gruiform Birds *Aramus giganteus*, Bonap, and *Rhinochetus kagu*: Dr. P. Chalmers Mitchell.

THURSDAY, MAY 27.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Annual General Meeting.

FRIDAY, MAY 28.

ROYAL INSTITUTION, at 9.—Engineering Problems of Mesopotamia and Euphrates Valley: Sir John Jackson.

INSTITUTION OF PETROLEUM TECHNOLOGISTS, at 8.—The Evolution of the Oil Tank-ship: H. Barringer.

PHYSICAL SOCIETY, at 5.—Numerical Relations between Electronic and Atomic Constants: Dr. H. S. Allen.—A Method of Calculating the Absorption Coefficients of Homogeneous X-Radiation: H. Moore. Two Experiments Illustrating Novel Properties of the Electron Currents from Hot Metals: Prof. O. W. Richardson.—High Permeability in Iron: Prof. E. Wilson.

SATURDAY, MAY 29.

LINNEAN SOCIETY, at 3.—Anniversary Meeting.

CONTENTS.

	PAGE
Science and the State. By **Sir William Ramsay, K.C.B., F.R.S.**	309
A Great Plant Collector	311
Applied Catalysis. By **J. F. T.**	312
A Text-book of Efficiency. By *φ*.	313
Our Bookshelf	314
Letters to the Editor:—	
The National Organisation of Scientific Effort.—"F.R.S."	315
Osmotics.—**The Earl of Berkeley, F.R.S.**	317
A Bibliography of Fishes.—**Prof. Bashford Dean**	318
The Use of the Term "Pinacoid" in Crystallography.—**Prof. Grenville A. J. Cole**	318
A Mistaken Butterfly.—**Edward A. Martin**	318
Ethnographic Studies in Melanesia. (*Illustrated.*) By **Dr. A. C. Haddon, F.R.S.**	319
Typhus Fever. By **R. T. H.**	321
An Advisory Council on Industrial Research	321
Notes	327
Our Astronomical Column:—	
Comet 1915*a* (Mellish)	332
Photographic Determinations of Stellar Parallax	332
Report of the Kodaikanal and Madras Observatories	332
Astronomy at Hampstead	332
Recent Work in Applied Biology. By **G. H. C.**	332
Mineral Resources of the Philippine Islands	333
University and Educational Intelligence	333
Societies and Academies	334
Books Received	336
Diary of Societies	336

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